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Undergraduate Student Perceptions and Awareness of Genetic Counseling

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UNDERGRADUATE STUDENT PERCEPTIONS AND AWARENESS OF GENETIC
COUNSELING

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COUNSELING

A

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UNDERGRADUATE STUDENT PERCEPTIONS AND AWARENESS OF GENETIC COUNSELING

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Genetic counseling (GC) is a rapidly expanding field, and the supply of certified genetic counselors is currently unable to keep up with job demand. Research is fairly limited regarding the awareness and perceptions potential genetic counseling program applicants have of the field and what factors most influence their interest in the field. This study aimed to examine some of these topics. The current study includes data collected from 1,389 undergraduate students in the sciences at 23 universities across the United States who were surveyed regarding information related to their awareness, perceptions, knowledge, and interest in GC. Data analysis was performed using STATA statistical software and included descriptive statistics, independent samples t-tests and ANOVA for continuous variables, and chi-square analysis for categorical variables. The majority of participants had heard of GC (78.0%), many from a high school course (37.3%), college course (28.1%), or online (11.5%). Familiarity was significantly associated with factors such as gender ($p = 0.003$), year in school ($p < 0.001$), and major ($p = 0.018$). Participants found hands-on experiences such as shadowing and internships to be most helpful for learning about the career. After taking the survey, participant interest was associated with several factors including gender (p

< 0.001) and ethnicity ($p = 0.012$). Commonly reported factors that attracted students to the field included direct patient care, the variety of roles available, cultural competency and psychosocial training, and helping others. Discussion elaborates upon specific factors related to student awareness and interest in GC and potential ways to tailor recruitment strategies for maximum benefit to the field. This includes recommendations for: (1) specific places to target efforts, such as high schools and science-related majors; (2) types of recruitment efforts to use, such as hands-on exposure opportunities and various online resources; (3) talking points for genetic counselors, such as helping others and various aspects of program training.

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INTRODUCTION

Advances in genetics have resulted in rapid expansion of the genetic counseling profession, with the number of jobs expanding faster than the number of counselors available to fill them. In response, genetic counseling programs are accepting more graduate students and several new genetic counseling programs are opening (ACGC, n.d.). As the field expands, genetic counseling programs will be faced with the challenges of providing the workforce with a diverse supply of qualified counselors. This expansion highlights the need to understand factors influencing undergraduate students' familiarity and perceptions of genetic counseling and what impacts students' interest in the field.

With the relatively small size of the field, it is plausible that a number of individuals well-suited for the career miss an opportunity due to lack of awareness or lack of accurate information. Assessing undergraduate student awareness and perceptions of the field of genetic counseling is crucial to recruiting talented and diverse students to genetic counseling graduate training programs and thus, the workforce. There are many demographic factors that are important when considering awareness and perceptions of genetic counseling. The majority of genetic counselors are Caucasian females (National Society of Genetic Counselors, 2016). Diversity in the field has been an area of discussion for many years, but this has not resulted in major changes to the field's demographic profile (Mittman & Downs, 2008). A previous study found that while minority students tend to be less aware of genetic counseling, they are just as likely to consider it once they are made aware of the field (Oh & Lewis, 2005). Studies have also shown differences in career factors of interest for individuals of different ethnicities (Schneider, Collins, Huether, & Warren, 2009). In terms of gender, studies differ in findings regarding whether males are as likely as females to consider a career in the field

(Kopesky, Veach, Lian, LeRoy, 2011; Oh & Lewis, 2005). In order to have a large and diverse workforce, it is important to further address unique factors that could play a role in the awareness and perceptions that students of different backgrounds have of genetic counseling.

To date, few studies have further examined factors influencing awareness and perceptions of the field. As there are likely complex ways that demographics and other factors interact, further research is needed. Studies addressing issues associated with awareness have found that many high school guidance counselors and biology teachers are not likely to discuss genetic counseling in detail as a career (Kumaravel, Tabangin, Sebera, & Warren, 2011; Owens, Tabangin, Huether, Bowling, & Warren, 2009). Another study found that only 60% of college students sampled had heard of genetic counseling. This increased with school level, with 75% of seniors reporting that they were aware (Schneider et al., 2009).

Similar to awareness, limited information is known about student perceptions of genetic counseling. Some characteristics such as salary and job responsibilities have been reported as both positive and negative aspects of the field and require additional investigation (Kopesky et al., 2011; Oh & Lewis, 2005). Although a study of genetic counseling program students found that common reasons for entering the field included interest in science, helping others, and intellectual stimulation (Lega, Veach, Ward, & LeRoy, 2005), information about students who consider but do not end up in the field is more limited. Further investigation could identify more effective ways of presenting genetic counseling to potential applicants.

The current study aimed to build upon previous studies. Because many students are introduced to genetic counseling in college (Kumaravel et al., 2011; Kopesky et al., 2011), this study was targeted at college students to examine a population that may be considering health-related careers. As program applicants commonly have science backgrounds (Lega et al., 2005;

Oh & Lewis, 2005), our study recruitment focused on students taking classes in the sciences. This study provides genetic counseling programs and professional organizations with information to improve recruitment strategies and identifies ways that practicing genetic counselors can increase interest in the field. This will help ensure that as the field continues to expand, there will be enough qualified students applying to genetic counseling programs. The study aimed to: describe the familiarity and perceptions college students involved in the sciences have of genetic counseling, determine how these students prefer to learn information about the field of genetic counseling, and determine what factors impact their interest in genetic counseling as a potential career path.

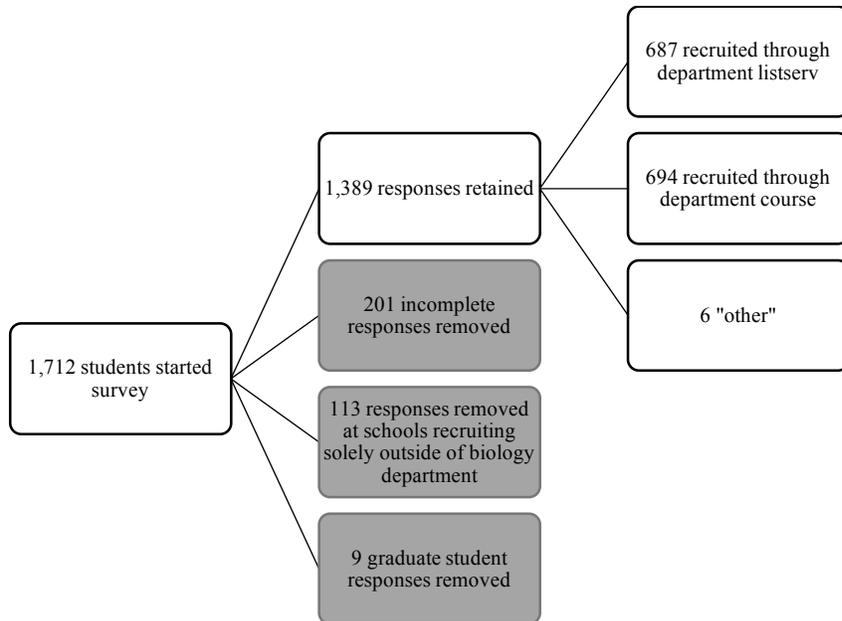
METHODS

Study Design

This was a cross-sectional study. Approval was obtained from the Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston (HSC-MS-16-0440). Biology department heads or other senior members at approximately 200 U.S. doctoral universities classified as having “highest” or “higher” research activity under the Carnegie Classification of Institutions of Higher Education (Indiana University Center for Postsecondary Research, 2015) were contacted via email. The initial email provided basic information about the study and asked the recipient to forward the email to department faculty members. Some of the initial points of contact chose to distribute the survey directly to students through department listservs, while others chose to forward the survey to department professors for distribution to students enrolled in fall courses. This allowed for a sample of students who came from a wide variety of majors, but who had a potential interest in the sciences because of their enrollment in a biology-related course or listserv.

Of the universities that were contacted, 26 universities participated. Students who completed the survey had the option to enter their email address into a raffle to win one of four \$50 Visa gift cards. 1,389 survey responses from 23 universities were included in data analysis out of a total of 1,712 survey responses (Figure 1).

Figure 1. Study Recruitment and Inclusion Methods.



Survey Design and Population

The survey was distributed using an anonymous link through Qualtrics online survey software (v. May 2016. Qualtrics, Provo, UT). The number of questions in the survey varied depending on whether participants reported prior familiarity with genetic counseling. The maximum number of questions was 35. Question types varied and included multiple choice, ratings scales, checklists, and free responses. The survey was designed to ascertain general demographic information of the respondent and to assess subjects' familiarity with genetic counseling, attitudes regarding aspects of a genetic counseling career, and preferences for obtaining information about the career. In an effort to decrease sample bias, no references were

made to genetic counseling until a participant clicked the survey link. A full copy of the survey can be found in Appendix A.

Male and female undergraduates were eligible to take the survey. The survey was only available in English. There were no other inclusion restrictions. A map demonstrating the geographic representation of participating institutions can be found in Appendix B.

Data Analysis

Data collection occurred from September 2016 through December 2016. Data was analyzed using STATA statistical software (v. 13.1. StataCorp LP, College Station, TX). A *p*-value of < 0.05 was considered statistically significant. Comparison of continuous variables across groups was performed using independent-samples *t*-tests and ANOVA (with *post-hoc* Tukey's HSD test) for normally distributed data, or Wilcoxon-Mann-Whitney tests and Kruskal-Wallis tests for non-normally distributed data. Categorical variables were compared using contingency tests (chi-square or Fisher exact). For free-response questions, emergent themes were identified to allow for quantitative data analysis.

RESULTS

Sample Characteristics

A summary of demographics can be found in Table 1. The average age of participants was 20 years (16-44 years). Participants were majority Non-Hispanic White (NHW) and majority female. Data was not available for comparison regarding the gender and ethnic breakdowns of the specific courses and listservs in which the survey was distributed. However, demographic information was compared with some populations that are similar but not identical to the current study population. Compared to general data from the National Science Foundation (NSF) in 2014 for students earning science and engineering bachelor's degrees, the current

sample appears to have more females and a somewhat different ethnic breakdown, particularly with more multiracial and Asian individuals and fewer Hispanic and African American individuals than expected. The varying gender and ethnic demographic profiles of the specific universities surveyed is likely to be contributing to the demographic variations identified in this sample. For example, schools with many survey respondents such as the University of Texas at Austin and Stony Brook University have fairly high ratios of Asian students, while other well-represented schools such as Brigham Young University and the University of Iowa tend to have a less diverse student population (Forbes, 2016).

The majority of participants (67.5%) spoke only English. Participants came from a variety of self-reported socioeconomic backgrounds but were most commonly middle or upper-middle class. Participants were well-distributed regarding their year in school. The most commonly reported major was a single major in biology (34%), but a wide variety of science and non-science related majors were reported.

Table 1. Demographic Information

	n	%
Race/Ethnicity		
Non-Hispanic White	827	59.6%
Asian	294	21.2%
Multiracial	126	9.1%
Black/African American	55	4.0%
Latino/Hispanic	59	4.3%
Other	27	2.0%
Number of Languages		
One	938	67.5%
Two	386	27.8%
Three or more	63	4.5%
Language (other than English)		
Other	212	15.3%
Spanish	158	11.4%
Chinese	75	5.4%

Hindi	40	2.9%
French	38	2.7%
Socioeconomic Status		
Poor	56	4.1%
Working class	130	9.4%
Lower-middle class	201	14.6%
Middle class	545	39.5%
Upper-middle class	414	30.0%
Upper class or Wealthy	34	2.5%
Year in College		
First year	322	23.2%
Second year	420	30.2%
Third year	322	23.2%
Fourth year	273	19.7%
Fifth year or higher	52	3.7%

Familiarity with Genetic Counseling

See Table 2. Slightly more than three-quarters of the students had heard of genetic counseling, reporting that they were either very familiar (4.8%), mildly familiar (31.5%), or had heard of genetic counseling but were not at all familiar with it (41.6%). Students who reported more familiarity with genetic counseling were more likely to correctly answer statements about job responsibilities of genetic counselors ($p = 0.011$) and were less likely to change their interest levels in genetic counseling after taking the survey ($p < 0.001$). Females reported higher levels of familiarity than males ($p = 0.003$). Reported familiarity increased with a participant's year in school ($p < 0.001$), with 31.7% of freshmen reporting that they had never heard of genetic counseling compared to 13.2% of seniors. Individuals who heard of the field earlier in school, through an extracurricular activity, or through personal experience reported more familiarity, while those who heard of the field online, through the media, or through an advisor reported less familiarity ($p < 0.001$). Individuals in biology-related majors reported more familiarity, while individuals in non-biology related majors reported less familiarity ($p = 0.018$). There was no

significant association between whether a participant graduated from a rural or urban high school and their reported familiarity with genetic counseling ($p = 0.215$)

Table 2. Factors Significantly Associated with Reported Familiarity with Genetic Counseling

	Very familiar (n) (%)	Mildly familiar (n) (%)	Heard of GC, but not familiar (n) (%)	Never heard of GC (n) (%)	p-value
Knowledge Questions Score*					0.011
<=50%	2 (3)	37 (8)	32 (6)		
51-75%	27 (40)	161 (37)	269 (47)		
>75%	38 (57)	240 (55)	277 (48)		
Pre-Survey to Post-Survey Change in Interest*					< 0.001
-3	3 (5)	0 (0)	0 (0)	0 (0)	
-2	1 (1)	20 (5)	19 (3)	11 (4)	
-1	7 (10)	42 (10)	94 (16)	68 (22)	
0	50 (75)	297 (68)	279 (48)	121 (40)	
1	5 (7)	49 (11)	154 (27)	86 (28)	
2	1 (1)	30 (7)	29 (5)	20 (7)	
3	0 (0)	0 (0)	2 (0)	0 (0)	
Gender					0.003
Female	55 (5)	323 (32)	430 (43)	198 (20)	
Male	12 (3)	109 (29)	147 (39)	106 (28)	
Year in School					< 0.001
First year	12 (4)	71 (22)	137 (43)	102 (32)	
Second year	13 (3)	112 (27)	186 (44)	109 (26)	
Third year	16 (5)	113 (35)	140 (43)	53 (16)	
Fourth year	25 (9)	119 (44)	93 (34)	36 (13)	
Fifth year or higher	1 (2)	23 (44)	22 (42)	6 (12)	
Where Participant Heard of GC					< 0.001
Elementary/middle school	5 (19)	12 (46)	9 (35)		
High school class	24 (6)	203 (50)	177 (44)		
College class	19 (6)	112 (37)	173 (57)		
Career fair	0 (0)	2 (50)	2 (50)		
Extracurricular activity	1 (10)	6 (60)	3 (30)		
High school advisor	0 (0)	2 (33)	4 (67)		
Online	6 (5)	36 (29)	82 (66)		
Family member/friend	3 (4)	26 (38)	40 (58)		
Personal/family experience	6 (75)	2 (25)	0 (0)		
In the media	0 (0)	22 (27)	60 (73)		
Other	2 (7)	10 (34)	17 (59)		
College advisor	1 (6)	5 (31)	10 (63)		
Major					< 0.001
Non-biology majors	5 (3)	28 (17)	70 (42)	63 (38)	
Biology-related majors	42 (5)	269 (35)	312 (41)	146 (19)	
Multiple or "other" majors	20 (5)	138 (31)	190 (43)	95 (21)	

* = percentages organized by column rather than row

Methods of Learning about Genetic Counseling

Participants reported that the most helpful resources when learning about a new career were more hands-on opportunities such as shadowing (88.9%), finding a part-time job or internship (87.1%), and interviewing people in the field (48.8%). Factors reported as most important to a participant when considering a new career included personal satisfaction (80.0%), helping others (58.3%), salary (53.8%), and job outlook (48.0%). Factors reported as least important included the amount of postgraduate education required (56.8%), job prestige (54.6%), research opportunities (48.7%), and a flexible location (45.4%).

Of students who reported some degree of prior familiarity with the field ($n = 1,083$), the most commonly reported settings of first hearing about genetic counseling were a high school class (37.3%), college class (28.1%), online (11.5%), in the media (7.6%), or through a family member/friend (6.4%). Most participants who reported some degree of familiarity with the field had never researched genetic counseling (80.7%). However, 8.1% of individuals reporting prior familiarity indicated that they had researched the field through a genetic counseling program website or social media page, the National Society of Genetic Counselors (NSGC)' website or social media (4.4%), genetic counseling blogs (3.9%), communication with a genetic counselor in person or through email/telephone (3.6%), the American College of Medical Genetics and Genomics (ACMG) website or social media (3.3%), other resources (3.1%), and shadowing a genetic counselor (1.4%).

Knowledge of Genetic Counseling

Participants who reported previous familiarity with genetic counseling were provided with seven true statements and five false statements and asked to mark all statements that they believed were part of a genetic counselor's job responsibilities. Participants were scored on how

many statements they answered correctly, and scores were stratified and compared using the criteria of less than or equal to 50% correct, 51-75% correct, and greater than 75% correct. There was no significant difference between where participants heard of genetic counseling and their stratified scores ($p = 0.224$). Most statements were answered correctly by the majority of participants (>74%). However, three statements were answered incorrectly by approximately half of participants. These were false statements indicating genetic counselors recommend cancer treatments based on a patient's genetic information (47.2% incorrect), perform gene therapy for patients who are good candidates (47.3% incorrect), and recommend reproductive options such as pregnancy termination based on a couple's chances of having a child affected with a genetic condition (55.5% incorrect). There were no significant differences in reported familiarity or interest in genetic counseling based on whether participants answered each of these questions correctly or incorrectly ($p > 0.05$), indicating that these misperceptions were unlikely to influence overall interest in the field.

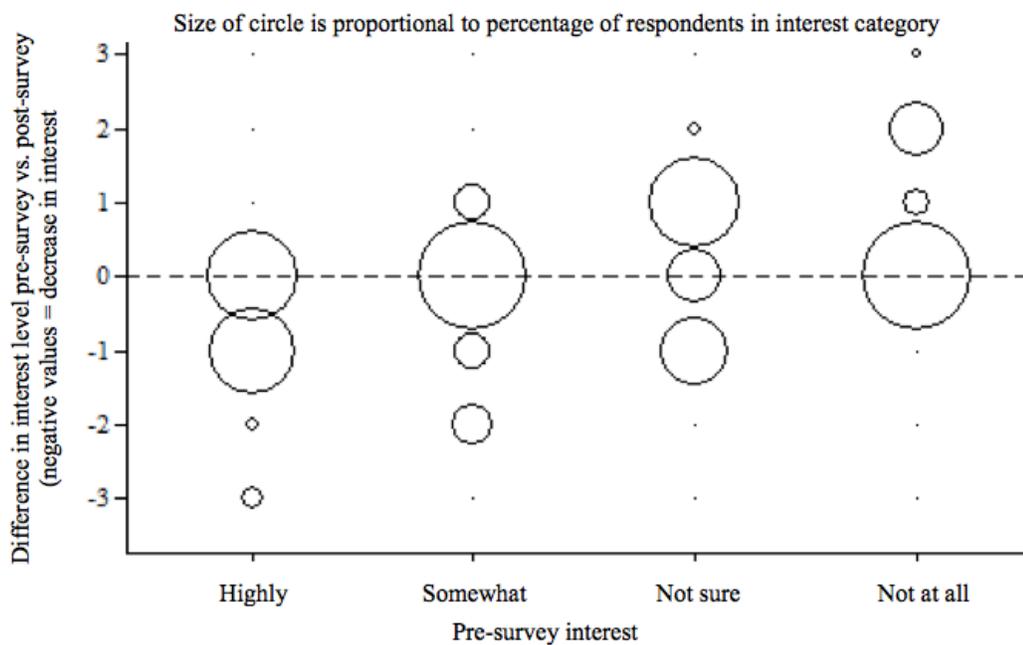
Aspects of Genetic Counseling and Student Interest

Participants were asked to indicate their level of interest in pursuing a genetic counseling career. Participants were then shown a brief explanation of genetic counseling in addition to several statements about a career in genetic counseling. Participants were asked to rate each statement from 1-5 according to how much it increased or decreased their interest in the field, with a score of 1 indicating a significant decrease in interest and a score of 5 indicating a significant increase in interest. After reading the summary and rating these statements, participants were asked again to indicate their interest level in genetic counseling.

Individual pre-survey and post-survey interest levels in genetic counseling were then compared to determine the extent to which participants individually increased or decreased in

their interest level after learning more about genetic counseling (Figure 2). Responses regarding interest were coded on a 1-4 scale, with “highly interested” as a 1 and “not at all interested” as a 4. Thus, a negative value reflects a decrease in interest pre-survey to post-survey, while a positive value reflects an increase in interest pre-survey to post-survey. Viewing more information about genetic counseling during the survey facilitated a change in interest levels for approximately half of participants ($n = 641$; 46.2%).

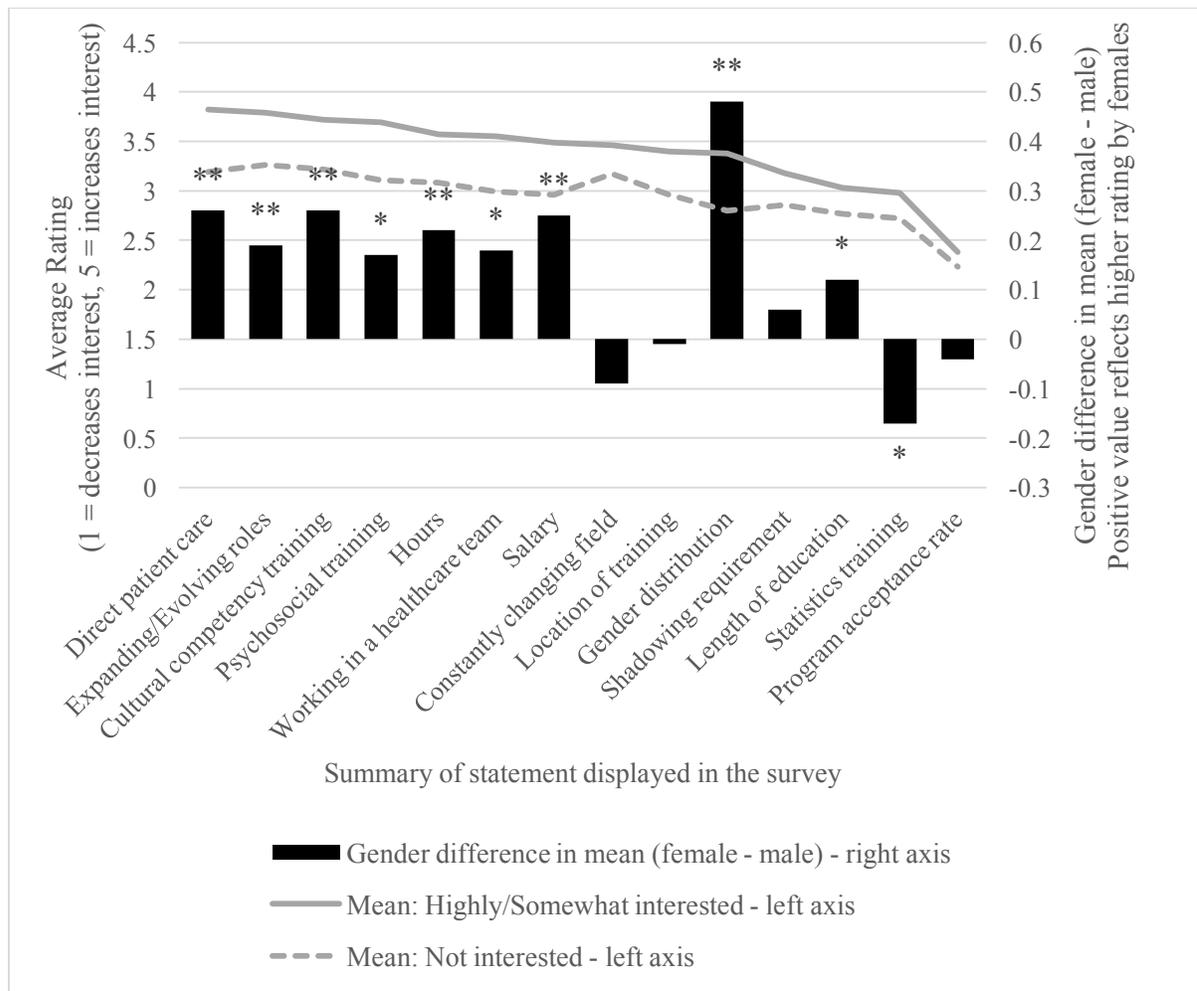
Figure 2. Difference in Interest Level Pre-Survey Versus Post-Survey



For participants who reported that they were highly or somewhat interested in genetic counseling after taking the survey, scores rating each presented statement about the career were averaged and compared to determine what aspects of the career were most appealing overall. Scores were also averaged for students who were not interested in genetic counseling. These students rated all aspects lower on average than did students who were highly or somewhat interested (Figure 3). Participants were also asked to answer free response questions regarding why they would ($n = 582$) or would not ($n = 766$) consider a genetic counseling career, and

common themes were elucidated. Commonly reported reasons for considering the field included helping others (29.2%), interest in genetics (26.8%), patient contact (21.3%), a general interest in the field (20.3%), an interest in healthcare (13.6%), and constant learning/evolving field (10.8%). Commonly reported reasons for not considering the field included a prior preference for another career (36.3%), a general lack of interest (16.1%), program acceptance rate (8.6%), salary (6.8%), no interest in genetics (5.4%), and no interest in patient interaction (5.0%).

Figure 3. Average Ratings of Genetic Counseling Aspects by Post-Survey Interest Levels in Genetic Counseling and Gender



* = significant difference at $p < 0.01$
 ** = significant difference at $p < 0.001$

Demographic Factors and Student Interest

Significant differences in gender, economic status, and ethnicity were not observed with pre-survey interest in genetic counseling ($p > 0.05$), but significant differences were observed in post-survey interest in genetic counseling at a minimum of $p < 0.05$ (Table 3). Specific factors that could contribute to gender differences are examined further in Figure 3. Several aspects of the career were rated significantly lower by males than females, with the number of women working in the field having the largest difference in average rating between males and females. The only finding rated significantly higher by males than females was a statement regarding the use of calculations and statistics to convey risk information. Regarding economic status, the average salary ($p < 0.001$) and the 96% female field ($p < 0.001$) statements were rated significantly lower by respondents from the upper class than by respondents from other economic groups, indicating that these statements were more negatively received by individuals from the upper class. Economic status was self-reported and did not include an indication of household income. Regarding ethnicity, Hispanic and Asian individuals were more likely to be interested in genetic counseling than were NHW, African American, and multiracial individuals, who all reported similar degrees of interest.

Conversely, religion was significantly associated with pre-survey interest ($p < 0.001$), but not post-survey interest ($p = 0.156$). Prior to taking the survey, Islam and Buddhist individuals appeared more likely to report interest in the field, while Mormon individuals appeared more likely to report that they were not interested in the field. These associations were not significant in the post-survey interest for any religious group. Year in college was also significantly associated with pre-survey interest ($p < 0.001$), with the proportion of students

reporting that they were unsure of their interest decreasing with each year in school. However, year in college was not significantly associated with post-survey interest ($p = 0.303$).

Finally, the student's chosen major was significantly associated with both pre-survey interest ($p < 0.001$) and post-survey interest ($p < 0.001$). Majors indicating highest levels of interest post-survey included public health, genetics, microbiology, neuroscience, biochemistry, and exercise science. Majors indicating lowest levels of interest post-survey included human physiology, pharmacy, environmental studies, premed, and engineering. Being a first-generation college student was also significantly associated with interest, with individuals whose parents had not attended college reporting higher levels of interest in genetic counseling both pre-survey ($p < 0.001$) and post-survey ($p < 0.001$).

Table 3. Factors Significantly Associated with Interest in Genetic Counseling

	Highly interested (n) (%)	Somewhat interested (n) (%)	Not sure, need more information (n) (%)	Not at all interested (n) (%)	p-value
Factors Significant Pre-Survey					
Religion					< 0.001
Protestant	23 (8)	94 (33)	79 (28)	88 (31)	
Catholic	12 (4)	91 (33)	95 (35)	75 (27)	
Mormon	1 (1)	31 (19)	80 (49)	52 (32)	
Jewish	3 (8)	12 (32)	10 (27)	12 (32)	
Islam	5 (9)	25 (46)	17 (31)	7 (13)	
Hindu	4 (8)	15 (29)	21 (40)	12 (23)	
Buddhist	2 (7)	11 (41)	9 (33)	5 (19)	
Unaffiliated	19 (8)	84 (34)	80 (32)	64 (26)	
Atheist	5 (3)	65 (42)	41 (26)	44 (28)	
Other	5 (6)	32 (39)	30 (37)	15 (18)	
Year in School					< 0.001
First year	19 (6)	89 (28)	140 (43)	74 (23)	
Second year	19 (5)	144 (34)	149 (36)	107 (26)	
Third year	25 (8)	101 (31)	107 (33)	89 (28)	
Fourth year	16 (6)	104 (38)	60 (22)	93 (34)	
Fifth year	0 (0)	26 (50)	11 (21)	15 (29)	
Major					< 0.001
Non-biology majors	9 (5)	31 (19)	81 (49)	45 (27)	
Biology-related majors	49 (6)	305 (40)	235 (31)	179 (23)	
Multiple or "other" majors	21 (5)	126 (28)	146 (33)	150 (34)	
First-Generation College Student					< 0.001

First-generation student	19 (8)	138 (58)	33 (14)	49 (21)	
Non-first-generation student	65 (6)	551 (48)	103 (9)	429 (37)	
Factors Significant Post-Survey					
Race/Ethnicity					0.012
White	50 (6)	380 (46)	81 (10)	316 (38)	
African American	4 (7)	27 (49)	5 (9)	19 (35)	
Hispanic	6 (10)	32 (54)	9 (15)	12 (20)	
Asian	18 (6)	173 (59)	24 (8)	79 (27)	
Multiracial	4 (3)	64 (51)	14 (11)	44 (35)	
Gender					< 0.001
Female	69 (7)	528 (52)	104 (10)	305 (30)	
Male	15 (4)	159 (43)	31 (8)	169 (45)	
Economic Status					0.013
Poor	3 (5)	29 (52)	10 (18)	14 (25)	
Working class	8 (6)	67 (52)	15 (12)	40 (31)	
Lower-middle class	10 (5)	114 (57)	21 (10)	56 (28)	
Middle class	33 (6)	271 (50)	57 (10)	184 (34)	
Upper-middle class	27 (7)	195 (47)	27 (7)	165 (40)	
Upper class or wealthy	3 (9)	8 (24)	5 (15)	18 (53)	
Major					< 0.001
Non-biology majors	8 (5)	75 (45)	18 (11)	65 (39)	
Biology-related majors	54 (7)	408 (53)	84 (11)	223 (29)	
Multiple or "other" majors	22 (5)	201 (45)	33 (7)	187 (42)	
First-Generation College Student					< 0.001
First-generation student	21 (9)	89 (37)	89 (37)	40 (17)	
Non-first-generation student	58 (5)	374 (33)	377 (33)	338 (29)	

Multi-variable models containing ethnicity, gender, economic status, and first-generation vs. non-first-generation college student were also evaluated. Respondents were more likely to report being interested in genetic counseling if they were first-generation college students than if they were not (OR 1.60 (95% CI: 1.22-2.11)). Although this effect was independent of ethnicity, this generational difference was more evident in Asians and African Americans compared to NHW or Hispanics. Conversely, ethnicity demonstrated a significantly higher likelihood of interest in genetic counseling if they were Asian than if they were NHW (OR 1.49 (95% CI: 1.15-1.93)). Although this trend was also observed for Hispanics and African Americans, it failed to reach statistical significance (data not shown). Males were less likely to be interested in genetic counseling (OR 0.57 (95% CI: 0.45-0.72)). However, economic status did not yield any

statistically significant trends. This is likely due to the high level of correlation between economic status and first-generation college students (35% of first-generation students were middle class or higher compared to 80% of non-first-generation students, $p < 0.001$).

DISCUSSION

This study contributes important findings to a body of literature exploring the awareness and perceptions potential genetic counseling program applicants have of the field in addition to factors that could influence student interest. Findings provide information regarding how students are currently learning about the field and support several recommendations regarding ways to consider improving recruitment efforts for the field and addressing diversity-associated issues, some of which also have support from previous studies.

Recommendations for Targeting Recruitment Efforts

When considering academic factors for recruitment, targeting high school or early college students could have a larger recruitment impact than targeting upperclassmen, as upperclassmen were significantly more likely to be familiar with genetic counseling and were more likely to have already selected a major ($p < 0.001$) than were freshmen and sophomores. Previous research asserts that learning about the field earlier, possibly even before high school, is ideal (Oh & Lewis, 2005; Mittman & Downs, 2008; Schneider et al., 2009; Owens et al., 2009). In addition, while many genetic counseling students are biology or genetics majors (Lega et al., 2005), it appears that students in other science-related majors may also have an interest in the field. Recruiting at science-related events or courses outside of those focused solely in biology or genetics could have potential recruitment benefits and bring students with new perspectives to the field.

Regarding demographic factors, individuals of low-middle socioeconomic status (SES) tended to report more interest in the field than those from the upper class, and this observation appeared to be related to whether an individual was a first-generation college student. Targeting efforts to schools that are more likely to have students from a variety of backgrounds that includes low-middle SES groups and more potential first-generation college students, for example targeting public schools rather than private schools, could help maximize recruitment efforts. Data also indicates that individuals outside of NHW ethnicity, particularly Asian individuals, might have a relatively high level of interest in the field. This demonstrates that recruiting in schools with ethnically diverse populations could be a beneficial endeavor. Factors related to aspects of the field that might have contributed to differences in interest by ethnicity could not be elucidated, and there were no significant differences in reported familiarity with genetic counseling across ethnicities. However, based on reported interest levels, it does appear that recruiting within culturally or ethnically-based student organizations could have potential benefits for diverse recruitment. Although some religious groups might initially be less open to genetic counseling and report lower interest levels, these differences in interest tend to dissipate once individuals learn more about genetic counseling. Therefore, there may be a benefit to speaking to religious groups that do not initially appear interested in genetic counseling and discussing any misconceptions they may or may not have about the field.

Recommendations for Specific Recruitment Strategies

Findings of the current study support specific types of recruitment strategies that are appealing to students. Because students tend to report the most interest in more hands-on exposure to careers of interest, genetic counselors should allow interested students to shadow or interview them whenever possible. Genetic counseling internships, hands-on recruiting events,

or similar learning experiences for interested students should also be established at institutions where this is possible. For example, the University of Texas Genetic Counseling Program has a yearly recruitment event that provides potential applicants with opportunities to hear both counselors and patients talk about the field, learn more about the program and how to become a competitive applicant, and participate in Q&A's with practicing counselors and current program students. In order to increase opportunities for students from lower SES groups or regions that do not have easy access to a genetic counselor, scholarships through NSGC or other organizations can be considered to help students have these experiences. Committees and task forces within NSGC are dedicated to these types of outreach activities and should consider the findings of this study for future outreach efforts.

Although in-person learning experiences are ideal, access to genetic counselors is often limited by the geographic location of practicing counselors and genetic counseling programs. For students who want these learning experiences but do not have direct access to a genetic counselor, there is a Master Genetic Counselor Series through the NSGC that presents simulated genetic counseling sessions from three specialty areas. Expanding upon this series, making it more interactive, and providing examples of more diverse counselors and settings could be beneficial, although these simulated sessions are not intended to be a substitute for shadowing experience.

A significant number of students reported first hearing of genetic counseling online or in the media, which supports the importance of positive media relations and exposure to genetic counseling. Webinars, chat rooms, or Q&A sessions through social media tools such as Reddit could disseminate information in a relatively hands-on way to potential student populations from a wide variety of geographic, demographic, and educational backgrounds. NSGC has

successfully participated in Reddit Q&A sessions in the past. Targeting some of these Q&A sessions specifically to student populations and including program directors, current students, and practicing counselors from various specialties could be beneficial. Use of similar interactive web tools has also been suggested in previous studies (Kumaravel et al., 2011; Mittman & Downs, 2008). These experiences could help students gain more knowledge about the field before deciding if they want to invest resources into seeking out more hands-on experiences and allow students to better determine what types of counselors they would prefer to shadow or interview.

Finally, in accordance with the Accreditation Council for Genetic Counseling (ACGC) Standards of Accreditation for Graduate Programs in Genetic Counseling, training programs should keep their websites up to date and have links or information to learn more about genetic counseling. The ACGC currently has recommendations in place for information that should be included on program websites in addition to suggestions for addressing diversity issues, such as scholarship opportunities and annual recruitment goals for underrepresented populations (ACGC, 2013). These standards are important and should continue to be tailored as more research about recruitment issues is published, especially because program websites were the most commonly reported resource used to learn more about the field. NSGC resources are also reported as a common source of information for students, and the NSGC currently has a variety of resources available for patients and students to learn about the field on their website. Consideration of methods to build upon these resources or to tailor them more effectively for different student populations could be beneficial.

Recommendations for Recruitment Talking Points

Based on participant changes in genetic counseling interest before and after taking the survey, it appears that viewing a fairly brief overview of genetic counseling is enough for many individuals to feel that they can make a decision on whether they are interested in the career. Less than 20% of individuals who were unsure about their interest in the field at the beginning of the survey stated that they were still unsure of their interest at the end of the survey, with approximately 30% stating that their interest had decreased and approximately 53% stating that their interest had increased. Similarly, the majority of individuals who had never heard of genetic counseling (60.5%) changed their interest levels in genetic counseling, with 34.6% of individuals increasing in interest. The fact that many individuals made a decision about the career after reading approximately 20 explanatory statements demonstrates a need to present some of the most positively-viewed statements first in order to capture interest and draw in as many individuals as possible.

Several aspects of genetic counseling were commonly mentioned as factors that increased an individual's interest in the field. These should be emphasized when discussing the field with students and include interpersonal aspects such as personal satisfaction, helping others, and working directly with people. Aspects of genetic counseling training that were frequently rated positively included training in genetics, cultural competency, and psychosocial issues. The Association of Genetic Counseling Program Directors (AGCPD) can integrate these aspects of training in their program's recruitment materials and on their websites.

In addition, participants had a few commonly held misconceptions about the field that would be important to clarify when discussing a career in genetic counseling. These included beliefs held by approximately half of participants that genetic counselors order genetic testing to

determine effective cancer treatments, perform gene therapy, and recommend reproductive options such as pregnancy termination. However, it is possible that there was some ambiguity in the pregnancy termination statement that caused some participants to answer it incorrectly. Although genetic counselors typically take a more nondirective approach and do not “recommend” options such as pregnancy termination, they do routinely discuss these options with patients. It is possible that some students may not have made this nuanced distinction when responding to the question.

Elucidation of points to emphasize when discussing genetic counseling also revealed some less well-received aspects that should continue to be objects of troubleshooting for the field. The program acceptance rate, which will likely change as new genetic counseling programs open, was negatively received by participants. In addition, the fact that the field is majority female tended to be less well-received by males than by females. Because males also rated many other aspects of genetic counseling lower on average than did females, it appears that there might be multiple factors contributing to the field’s gender discrepancy including the roles available within and outside of patient care, typical hours, and average salary. Previous research asserts that factors outside of gender discrepancy are likely to play a role in male interest in the field (Kopesky et al., 2011). However, the number of females in the field was still the biggest area of discrepancy between male and female ratings, and it appears that this is a deterrent for at least some males.

Study Limitations

To the knowledge of the authors at the time of publication, the current study is one of the largest studies to date examining the perceptions and awareness undergraduate students have of the genetic counseling field. The sample used for data analysis includes students from a wide

variety of locations, backgrounds, ethnicities, and majors, providing data about many different groups that have not always been well-characterized in research to date. This study makes beneficial and important contributions to research regarding ways to improve genetic counseling recruitment strategies.

However, the current study also has limitations that should be considered when interpreting results. First, participants were recruited using different methods according to the preference of their university, with some being recruited through department listservs ($n = 687$) and others being recruited through department professors ($n = 694$). There were some differences between students recruited from these different groups, although this could be expected considering that these two groups are likely to represent somewhat different majors and interests overall. These included differences in gender ($p < 0.001$) and ethnic breakdown ($p < 0.001$) between groups, with more males present in the group who received the survey through a course professor (33.0%) versus a listserv (21.5%). More NHW and fewer Asian students were also present in the group who received the survey through a course professor (68.6% NHW, 16.1% Asian) versus a listserv (53.3% NHW, 26.6% Asian).

Similarly, there were differences in responses to genetic-counseling related questions. For example, students who received the survey through a department listserv reported more familiarity ($p < 0.001$), with 26.8% of participants who received the survey through a professor reporting that they had never heard of genetic counseling compared to 17.2% of participants who received the survey through a department listserv. Individuals who received the survey through a department listserv versus a course professor also had higher levels of interest pre-survey (26.0% not interested vs. 28.5%) and post-survey (31.0% not interested vs. 37.9%) ($p < 0.001$). The number of correct responses to knowledge statements about genetic counseling was

not significantly different between the two groups ($p = 0.522$). Although this indicates that these two groups represent slightly different populations overall and results might have been somewhat different if each group were examined separately, both groups would likely be reached through the same types of recruitment methods and are important to understanding recruitment issues associated with students in the sciences. Thus, both groups were analyzed together to assess overall awareness and perceptions of students in the sciences.

In addition, the large sample size in this study provided power to identify statistically significant differences, even when the actual magnitude of the differences was not very large. The results of this study need to be interpreted not only in light of their statistical significance, but also with an appreciation of their potential for real-world recruitment utility or lack thereof. Survey measures were developed by the authors and were not validated.

Future Directions

The current study includes many findings that could be examined further in future studies. For example, there were several significant findings regarding various demographic factors such as ethnicity, socioeconomic status, and gender in relation to interest in genetic counseling and various perceptions of the field. It was especially surprising that Asian individuals were likely to demonstrate some of the highest levels of interest in genetic counseling when only 6% of genetic counselors who completed the 2016 Professional Status Survey identified as Asian (NSGC, 2016). It is unclear from the current study whether students from minority groups are applying to genetic counseling programs and are less likely to be accepted, or whether these individuals might be less likely to apply to programs for reasons other than interest alone. Studies that further characterize these different groups and the factors that could be influencing their interests in the field and their reasons for applying or not

applying to programs could be very beneficial to further improve recruitment strategies to increase the diversity of the genetic counseling field. While some studies have started to examine recruitment issues for specific gender and ethnic groups, (Kopesky et al., 2011; Mittman & Downs, 2008; Schneider et al., 2009; Schoonveld, Veach, & LeRoy, 2007), further research is warranted.

In addition, future studies could be helpful in further elucidating student knowledge of genetic counseling, common student beliefs about a genetic counselor's job responsibilities, and how these beliefs influence their interest in the field. Further characterizing awareness and perceptions for students in high school or earlier could also provide valuable recruitment insight. Finally, although there were many students whose interest level in genetic counseling decreased after taking the survey, the only career aspects statement that was negatively received by participants overall was the statement regarding program acceptance rates. It is unlikely that acceptance rate alone contributed to this decline in interest, and participants did mention some other contributing factors in the free response questions such as preference for another career, salary, and lack of interest in genetics or patient interaction. Further examination of different factors contributing to interest in the field could elucidate new findings that might have also contributed to these decreases in interest.

Findings of the current study also include suggestions that can be used by genetic counseling programs, NSGC, AGCPD and other genetic counseling organizations to develop recruitment tools and informational resources about the field of genetic counseling in addition to improving current recruitment strategies. We encourage these organizations to work together by pooling resources and sharing initiatives to more effectively improve recruitment efforts.

APPENDIX A

Copy of Survey

College Student Awareness of Careers in Healthcare

Q1 The University of Texas Health Science Center at Houston
INFORMED CONSENT FORM TO TAKE PART IN RESEARCH

Title: Undergraduate Student Perceptions and Awareness of Genetic Counseling

Letter of Information (HSC-MS-16-0440)

Primary Investigator: Amanda Gerard, BA

You are invited to take part in a research study called, “Undergraduate Student Perceptions and Awareness of Genetic Counseling”, conducted by Amanda Gerard, of the University of Texas Health Science Center at Houston (UTHealth). For this research project, she will be called the Principal Investigator or PI.

The purpose of this study is to examine college student perceptions and awareness of the field of genetic counseling. This study does not require any prior knowledge of genetic counseling. If you decide to take part in the study, the total time commitment is 10-15 minutes. You are invited to take part in this study because you are a college student. The questions asked will include demographic information, your career interests, and your perceptions and familiarity with the field of genetic counseling. Taking part is voluntary. You can refuse to answer any questions asked or written on any forms. Participation in this study is voluntary. A decision not to take part in this study will not change the services or your attendance at any university. You may not receive any benefit from taking part in this study. The information you provide will help us better understand perceptions and awareness of genetic counseling. There are no known risks to take part in this study. The information collected will not contain identifying information. You will be offered the opportunity to take part in a drawing, which will require your e-mail address. If you agree to provide your e-mail address, the only risk may be possible breach of confidentiality. You have the alternative to choose to not take part in this study and can withdraw at any time.

There is no cost and you will not be paid to take part in this study. Upon completing the survey, you will be offered the option to enter your email address to participate in a raffle for one of four \$50 gift cards. This information is not required. You will not be personally identified in any reports or publications that may result from this study. Any personal information about you that is gathered during this study will remain confidential to every extent of the law. You must be 18 years of age or older to take part in this study. If you have any questions about this project, please contact Amanda Gerard at Amanda.Gerard@uth.tmc.edu.

Proceeding with the survey implies consent to participate.

This research project has been reviewed by the Committee for the Protection of Human Subjects (CPHS) of the University of Texas Health Science Center at Houston (HSC-MS-16-0440). For any questions about research subjects’ rights call CPHS at (713) 500-7943.

Q2 The following survey is designed to take approximately 10-15 minutes and asks general demographic questions in addition to more specific questions about career decisions and the field of genetic counseling. This survey does not require any prior knowledge of genetic counseling. The progress bar at the top will display how much of the survey is remaining. The

survey will not allow you to go back once you have progressed to a new page, so please make sure that your answers on each page are final before clicking the “next” button.

Q3 Please select your gender.

Female (1)

Male (2)

Other (3)

Prefer not to answer (4)

Q4 Please enter your age.

Q5 Please select your race/ethnicity. Please select all that apply.

White (1)

Black or African American (2)

Latino or Hispanic (3)

American Indian or Alaska Native (4)

Asian (5)

Native Hawaiian or Pacific Islander (6)

Other; please specify: (7) _____

Q6 Please select all languages that you speak fluently (check all that apply).

English (1)

Spanish (2)

Chinese (3)

Arabic (4)

French (5)

Hindi (6)

Other; please specify: (7) _____

Q7 Please select your religious affiliation.

Protestant (Methodist, Baptist, Presbyterian, Lutheran, etc.) (1)

Catholic (2)

Mormon (3)

Jewish (4)

Islam (5)

Hindu (6)

Buddhist (7)

Unaffiliated (8)

Atheist (9)

Other, please specify: (10) _____

Q8 What was the highest level of education your mother/female guardian completed?

Did not complete high school (1)

High school/GED (2)

Some college (3)

Associate's degree (4)

Bachelor's degree (5)

Master's degree (6)

Advanced graduate work or Ph.D. (7)

I grew up in a single parent household and did not live with my mother/female guardian (8)

Q9 What was the highest level of education your father/male guardian completed?

Did not complete high school (1)

High school/GED (7)

Some college (2)

Associate's degree (3)

Bachelor's degree (4)

Master's degree (5)

Advanced graduate work or Ph.D. (6)

I grew up in a single parent household and did not live with my father/male guardian (8)

Q10 How would you describe your family's economic status when you were a child?

Poor (4)

Working class (5)

Lower-middle class (6)

Middle class (7)

Upper-middle class (8)

Upper class or wealthy (9)

Q11 Please enter the zip code where you graduated high school.

Q12 Please select the name of your current undergraduate institution.

Answer If Please select the name of your current undergraduate institution. My university is not listed Is Selected

Q13 Please enter the name of your current undergraduate institution.

Q14 How did you receive this survey?

Through a course professor - please specify the course name: (1)

Through an email list for my major or program (2)

Not sure (3)

Q15 Please select your current major of study. If you have more than one major, please select all that apply.

Biology (1)

Psychology (2)

Genetics (3)

Biochemistry (4)

Chemistry (5)

Microbiology (6)

Physics (7)

Engineering (8)

Pharmacy (9)

Pre-Med (10)

Nursing (11)

Exercise science (12)

Forensic science (13)

Public health (16)

Undecided (14)

Other; please specify: (15) _____

Q16 Please select your current minor of study. If you have more than one minor, please select all that apply.

Biology (1)

Psychology (2)

Genetics (3)

Biochemistry (4)

Chemistry (5)

Microbiology (6)

Physics (7)

Engineering (8)

Pharmacy (9)

Pre-Med (10)

Nursing (11)

Exercise science (12)

Forensic science (13)

Public health (16)

Undecided (14)

Other; please specify: (15) _____

Q17 What is your current GPA on a 4.0 scale?

Q18 Please select the year of college you are currently in.

First year (1)

Second year (2)

Third year (3)

Fourth year (4)

Fifth year or higher (5)

Graduate student (6)

Q19 If you have chosen a career path, how certain are you about your career choice?

Very sure (1)

Somewhat sure (2)

Somewhat unsure (4)

Very unsure (5)

I have not chosen a future career path (6)

Q20 What types of resources would you find most helpful when exploring potential career options? Please select your top 3 choices.

Blogs or newsletters run by people currently involved in the field (1)

Interviewing people who are working in the field by phone/email or in person (2)

Shadowing someone involved in the field to see what their job is like (3)

Finding a part-time job or internship in the field (4)

Websites of national organizations related to the field of study (5)

Websites of postgraduate programs in the field of study (6)

Websites of places of employment in the field of study (7)

Social media pages (Facebook, Twitter, etc.) related to the field of study (8)

Other; please specify: (9) _____

Q21 From the following list, please check approximately 3 items that are MOST important to you when selecting a career and approximately 3 items that are LEAST important to you when selecting a career.

	Most Important (1)	Least Important (2)
Salary (1)	1.	2.
Opportunities for career advancement (2)	3.	4.
Job outlook/likelihood of finding a job (3)	5.	6.
Prestige (4)	7.	8.
Personal satisfaction (5)	9.	10.
Amount of postgraduate education required (6)	11.	12.
Being challenged (7)	13.	14.
Helping others (8)	15.	16.
Flexible hours (9)	17.	18.
Flexible location (10)	19.	20.
Research opportunities (11)	21.	22.

Q22 Are you considering a healthcare-related career post-graduation?

Yes (1)

No (2)

Not sure (3)

Q23 How familiar are you with the field of genetic counseling?

Very familiar (1)

Mildly familiar (2)

I have heard of genetic counseling, but I am not at all familiar with it (3)

I have never heard of genetic counseling (4)

Q24 Please indicate your level of interest in exploring genetic counseling as a career choice.

Highly interested (1)

Somewhat interested (2)

Not at all interested (3)

Not sure, need more information (4)

Answer If How familiar are you with the field of genetic counseling? I have never heard of genetic counseling Is Not Selected

Q25 Where did you first hear about genetic counseling?

Elementary or middle school class (1)

High school class (2)

College class (3)

High school academic advisor (6)

College academic advisor (12)

Career fair (4)

Extracurricular activity (5)

Online (7)

Through a family member/friend (8)

Personal or family experience (9)

In the media (10)

Other; please specify: (11) _____

Answer If How familiar are you with the field of genetic counseling? I have never heard of genetic counseling Is Not Selected

Q26 Please select any resources you have used to learn more about genetic counseling. Select all that apply.

I have not researched genetic counseling (1)

National Society of Genetic Counselors website/social media (2)

American College of Medical Genetics website/social media (3)

Genetic counseling program websites/social media (4)

Genetic counseling blogs such as Maps and Genes, MicroEMORAY, etc. (5)

Communication with a genetic counselor in person or via email, telephone, etc. (6)

Shadowing a genetic counselor (7)

Other; please specify: (8) _____

Answer If How familiar are you with the field of genetic counseling? I have never heard of genetic counseling Is Not Selected

Q27 Are you considering applying to graduate programs in genetic counseling?

Yes (1)

No (2)

Not sure (3)

Q28 The remaining questions are designed to look at college student awareness and perceptions of genetic counseling. Please answer the questions to the best of your ability regardless of whether you have any prior familiarity with genetic counseling.

Q29 This is the definition of genetic counseling provided by the National Society of Genetic Counselors: Genetic counseling is the process of helping people understand and adapt to the medical, psychological and familial implications of genetic contributions to disease. This process integrates: Interpretation of family and medical histories to assess the chance of disease occurrence or recurrence. Education about inheritance, testing, management, prevention, resources and research. Counseling to promote informed choices and adaptation to the risk or condition. Basic requirements for postgraduate programs in genetic counseling generally include a bachelor's degree and completion of prerequisite courses in biological sciences, social sciences, and statistics in addition to the GRE, letters of recommendation, a personal statement, and advocacy/shadowing experience.

Q30 The following statements represent different aspects of a career in genetic counseling. Please select the degree to which each statement increases or decreases your interest in genetic counseling.

_____ The field of genetics is rapidly changing, so genetic counselors must make an effort to keep themselves up to date on the latest discoveries in the field. (1)

_____ Genetic counselors are required to have a specialized 2-year master's degree from an accredited genetic counseling program. (2)

_____ Requirements for genetic counseling programs generally include advocacy/shadowing experience prior to applying. (14)

_____ The 32 genetic counseling programs are located in major metropolitan areas and require the student to spend the duration of their training in the area. (3)

_____ Genetic counselors typically work as part of a health care team headed by a medical doctor. (4)

_____ Genetic counselors receive psychosocial training so they can help patients through the psychological impacts of genetic testing or genetic diagnosis. (5)

_____ The average salary for a full-time genetic counselor is \$74,000. (6)

_____ 96% of genetic counselors are women. (7)

_____ Genetic counselors see patients of many different ethnic backgrounds and are required to have an understanding of many cultures. (8)

_____ Genetic counselors are required to be able to calculate and understand many types of statistics in order to accurately convey risk information. (9)

_____ Most genetic counseling programs have approximately 100-200 applicants and accept 5-10 students yearly. (10)

_____ Genetic counselors generally work typical office hours, and part-time jobs are available. (11)

_____ Clinical genetic counselors spend a great deal of time in direct patient care. (12)

_____ Genetic counselors have many options for roles outside of clinical care. (13)

Q31 After learning more about genetic counseling, please indicate your level of interest in exploring genetic counseling as a career choice.

- Highly interested (1)
- Somewhat interested (2)
- Not at all interested (3)
- Not sure, need more information (4)

Q32 If you would consider a career in genetic counseling, please give a brief explanation of why you would.

Q33 If you would NOT consider a career in genetic counseling, please give a brief explanation of why you would NOT.

Answer If How familiar are you with the field of genetic counseling? I have never heard of genetic counseling Is Not Selected

Q34 From the following list, please select all options that you believe are within a genetic counselor's job responsibilities. Check all that apply.

- Perform ultrasounds and discuss findings with patients (1)
- Talk about birth defects (ex. cleft lip, heart problems, etc.) and genetic conditions (2)
- Recommend reproductive options such as pregnancy termination based on a couple's chance of having a child affected with a genetic condition (3)
- Help patients deal with feelings about how genetic conditions affect them and their families (4)
- Perform gene therapy for patients who are good candidates (5)
- Explain the chances of a genetic condition occurring or recurring within a family (6)
- Help expecting couples choose options for their babies' genetic makeups such as eye color, hair color, etc. (7)
- Recommend cancer treatments based on a patient's genetic information (12)
- Discuss testing options that can help diagnose a genetic condition (8)
- Disclose and explain genetic test results to patients (9)
- Ask questions to gather information about a patient's medical and family history (10)
- Help certain cancer patients determine whether they have a hereditary form of cancer (11)

Q35 If you would like to enter a voluntary raffle for participation, please enter your email address for one of four \$50 Visa gift cards. Your information will not be distributed, and you will not be contacted unless you are a raffle winner.

Thank you for completing this survey. If you have questions about this research study, please contact Amanda Gerard at Amanda.Gerard@uth.tmc.edu. If you are interested in learning about genetic counseling, more information can be found through the National Society of Genetic Counselors at <http://nsgc.org>.

This research project has been reviewed by the Committee for the Protection of Human Subjects

(CPHS) of the University of Texas Health Science Center at Houston (HSC-MS-16-0440). For any questions about research subjects' rights call CPHS at (713) 500-7943.

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