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UNIVERSITY OF CALIFORNIA, IRVINE

Assessing Undergraduate Advisors' Comfort Advising on Genetic Counseling

THESIS

Submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

in Genetic Counseling

by

Madison McFarland

Thesis Committee:
Professor Moyra Smith, M.D., PhD, Chair
Professor Pamela Flodman, MSc, MS, LCGC
Assistant Professor Rebecca LeShay, MS, LCGC

2021

DEDICATION

To

my Papa

who would have been very proud.

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ABSTRACT OF THESIS

Assessing Undergraduate Advisors' Comfort Advising on Genetic Counseling

By

Madison McFarland

Master of Science in Genetic Counseling

University of California, Irvine, 2021

Professor Moyra Smith, Chair

Genetic counseling is a rapidly growing profession that is constantly evolving. However, the field is significantly lacking in awareness and diversity. To increase awareness about genetic counseling and subsequently diversity within the field, new recruitment strategies must be put in place. Reaching students when they are searching for a career in an undergraduate setting, potentially different from the one they originally intended to pursue, could help attain this goal. Previous studies indicated that most college career advisors felt not at all confident in discussing genetic counseling with their students. An additional study noted that undergraduate students who had heard of genetic counseling through their undergraduate advisors were reportedly very unfamiliar with the profession. In the present study, undergraduate advisors were surveyed to assess their comfort level advising on genetic counseling and how that comfort level was impacted by an informational video intervention. Sixty-seven participants were asked demographic questions, about pre-survey confidence level and 12 knowledge questions before and after the viewing of an information video intervention regarding the genetic counseling profession and graduate program requirements. Ninety percent of participants reported hearing of genetic counseling prior to the study and 75% had experience advising students regarding the field. There was a positive mean difference in scores based on correctness of response to the knowledge questions from the pre- to post-survey among all participants regarding the genetic counseling profession and

graduate program requirements (1.3 point and 1.2 point increase respectively, $p < 0.0001$ and $p = 0.02$ respectively). While some questions, particularly those related to the profession, were answered correctly by most participants in the pre-survey indicating generalized prior knowledge, many other questions, particularly those related to the graduate program requirements, were greatly impacted by the information in the video based on improvement in correct responses in the post-survey. More than 65% of participants that opened the survey completed the full pre- and post-survey illustrating their interest in learning more about the genetic counseling profession and how best to advise their students. The data indicates the importance of mass distribution of information regarding the profession to various types of undergraduate advisors. Future studies may focus the knowledge questions more on the genetic counseling graduate program requirements and consider extending the length of the video intervention to extend further knowledge to this population.

INTRODUCTION

The History of Genetic Counseling

The history of genetic counseling is rooted in a school of thought riddled with stigma. This school of thought is known as eugenics. Though it has since been separated from genetics, the early beginnings of genetic counseling will always have roots in eugenics. Eugenics is defined in the Merriam Webster dictionary as “*the practice or advocacy of controlled selective breeding of human populations (as by sterilization) to improve the population's genetic composition*” (Webster, 2021).

The practice of eugenics began to take hold in the late 1800s as genetics knowledge grew. It was not until after World War II and the horror of the Holocaust, that medical genetics and subsequently genetic counseling began to emerge from the shadow of eugenics. Over the years, it has been difficult to parse out where eugenics truly ended in society and genetic counseling began. During the transition, genetic counseling was not regarded as a necessary or valuable practice within the scope of public health due to this history (Resta et al., 1997).

Genetic counseling as we know it traces its early history back to the Dight Institute for Human Genetics which was founded in 1941 in Minneapolis, Minnesota (Reed, 1974). Dight was a physician and a former member of the Eugenics society. He was particularly interested in funding a clinic that had the ability to offer both hereditary and eugenics advice to couples interested in reproducing. This practice of advice-giving had been labeled multiple different ways including genetic consultation, genetic advice, and genetic hygiene. In 1947, Sheldon Reed, a non-physician with a doctorate in genetics, took control of the Institute and reinvented this advice-giving practice (Resta et al., 2006). He coined the term genetic counseling, different from the other terms previously used in that genetic counseling was a “kind of social work with eugenic connotations” (Paul, 2011). Reed emphasized the

importance of respect and care for his clients along with the acknowledgement of any shame and guilt that his “clients” may have felt due to the stigma that lingered from the eugenics movement (Resta et al., 2006).

Despite Reed’s efforts, this form of genetic counseling was disregarded as a form of public health and it has been suggested that society at the time may have viewed genetic counseling as useless, forming a societal construct that only added to the shame that individuals felt when seeking these services (Reed, 1974). Geneticists at the time continued to encourage the act of influencing a couple’s decision to reproduce based on their genetic makeup. Therefore, genetic counseling at the time continued to be a much more directive process compared to the modern form of counseling that is performed today (Resta et al., 2006). Even Reed “never denied that he or other postwar medical geneticists were concerned with population improvement” but he emphasized the importance of counseling and its distinction from this concern. As Reed stated, “There were certainly no attempts to benefit society as a whole in dealing with these families. This was not thought of as a program of eugenics” (Paul, 2011). At the time, the counseling aspect of the session began to truly distinguish eugenics from modern genetic counseling.

The Genetic Counseling Profession

In the early 1970’s, the first graduates from newly developed graduate programs in genetic counseling began to enter the workforce and join the American Society of Human Genetics (ASHG), and genetic counseling began to truly take its modern form.

However, establishing genetic counselors as professionals and not simply assistants, especially from the perspective of medical geneticists at the time, was very difficult to accomplish. It was not until 1979 that genetic counselors had their own society, the National Society of Genetic Counselors (NSGC) and began to find solid ground as a profession. The eight long years that it took to establish this society were trying and carried a lot of weight in

terms of the future of the profession (Heimler, 1997). An early committee member, Luba Djurdjinovic, stated in 1994

“How we do this will determine how we will be perceived. We are charged with the responsibility of defining the profession of genetic counseling and the professional who is a genetic counselor. The by-laws of the proposed society will set the tone for the profession” (Heimler, 1997).

One of the major points of discussion throughout this period was how to title this new professional: genetic associate or genetic counselor. At the time, it was suggested that most medical geneticists considered themselves genetic counselors. The proposed society would not include medical geneticists as full members, as the goal of this new professional was to become independent. There was a great deal of conflict regarding whether or not this should be the case moving forward particularly from medical geneticists (Heimler 1997). Charles Epstein, M.D. a medical geneticist stated in 1973 that

“To me, the term ‘genetic counselor’ connotes one who is capable of giving genetic counseling, with all that it entails. It is my contention, and I am prepared to be proven wrong, that except in the rarest of instances, non-medically trained individuals are not so prepared... I do not regard these individuals as ‘genetic counselors’... associates, assistant, aides, collaborators, yes; counselors, no!” (Heimler 1997)

Despite this ongoing controversy, it was determined that “graduates of master’s degree training programs were equipped to provide genetic counseling and should be called ‘genetic counselors’” in 1979 and the National Society of Genetic Counselors was born (Heimler 1997). Today, geneticists and genetic counselors work alongside one another to

provide their patients with ideal comprehensive care. However, it is important to recognize this history and the potential conflict that it may continue to cause in this relationship.

Since Reed's early definition in the 1940s, there have been many definitions of genetic counseling published that attempted to redefine the practice as it continued to evolve. The American Society of Human Genetics defined genetic counseling in 1975 as a communication process that follows a stepwise manner to allow an individual or family to comprehend, appreciate and understand their genetic risk to then choose a course of action. Later, the Human Genome Project Information team acknowledged genetic counselors as a true part of a health care team (Resta et al., 2006). Genetic counselors as professionals have been defined by the NSGC as having:

“advanced training in medical genetics and counseling to interpret genetic test results and to guide and support patients seeking more information about [...] how inherited diseases and conditions might affect them or their families, how family and medical histories may impact the chance of disease occurrence or recurrence, which genetic tests may or may not be right for them and what those tests may or may not tell, and how to make the most informed choices about healthcare conditions” (NSGC, 2020).

The most recent definition of the genetic counseling profession as described by The Genetic Counseling Definition Task Force of the National Society of Genetic Counselors (NSGC) was published in 2006 and is as follows:

“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 the following:

- *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.”*

(Resta et al., 2006)

Based on this definition, genetic counseling continues to integrate disease prevention into its practices. However, disease prevention does not include direct reproductive control. The goal of preventing disease has evolved to become a much more individualized decision for each person or couple that seeks genetic counseling services, with appropriate guidance and support from a trained genetic counselor.

The profession of genetic counseling is constantly growing and evolving as medical genetics advances at an increasingly rapid pace. Therefore, not only is the demand for genetic counselors increasing, but also the demand for a large variety of specialties within the profession. The majority of genetic counselors continue to work in a hospital or clinic setting alongside physicians and can specialize in a multitude of areas. The most common specialties within genetic counseling are prenatal/preconception, pediatric and cancer. However, approximately 24% of genetic counselors work in a subspecialty clinical setting such as cardiovascular, neurology or in a non-clinical setting such as research, education or laboratory positions (NSGC, 2021).

According to the Bureau of Labor Statistics, the average salary for a genetic counselor in the United States is almost \$95,000, with the highest 10% earning more than \$114,000. The job outlook, or the change in the number of people that are employed in a certain occupation over a selected period of time, for genetic counseling is an increase of 21%, which

is much greater than the average for all occupations at about 8% (Bureau of Labor Statistics, 2020 and NSGC, 2021).

Genetic Counseling Graduate Programs

In 1971, the first class of genetic counseling masters' students graduated from Sarah Lawrence College and within the next five years six additional genetic counseling graduate programs were established (NSGC, 2020). Today, there are 54 total accredited training programs in genetic counseling in the United States and Canada and over 5,000 board certified genetic counselors in the United States (ACGC, 2021 and NSGC, 2021).

To become a certified genetic counselor, an individual must complete one of the accredited graduate programs in genetic counseling and pass the board of genetic counseling exam. Genetic counseling graduate programs must meet specific requirements outlined by the Accreditation Council of Genetic Counseling (ACGC) to properly train future genetic counselors. The 'Standards of Accreditation' include requirements for the program's administration, curriculum and instruction, student evaluation practice, and accreditation status (ACGC, 2020).

However, these graduate programs have not always been fully accredited. Over the years, the ACGC has created guidelines for these training programs that has shaped the way genetic counselors learn their practice. However, it was not an easy road to pave. As the number of programs began to increase rapidly in the 1980s and early 1990s, there was an apparent need for both existing and newly established programs to gain accreditation. This is when the American Board of Genetic Counseling (ABGC) stepped in and paved the way for how genetic counseling training programs function today. It was no small feat, but in 1995, genetic counseling programs began receiving full accreditation by the ABGC (American Board of Genetic Counseling, 2021). In 2012, a separate council, called the Accreditation

Council of Genetic Counseling (ACGC), was created to focus on the continued accreditation of these programs (Yashar, 2010).

Most graduate programs in genetic counseling take approximately two years to complete, including course work in medical genetics/genomics, counseling skills, bioinformatics, and ethical, legal, and social issues in genetic counseling. All programs contain a research component (either a completed thesis or capstone project) as well as clinic-based experience of around 900 hours across the two-year program. This clinic experience spans across specialties and must include a variety of patient referral indications (NSGC, 2020).

Expectations for an application vary across graduate programs, however there are many commonalities amongst the requirements. The majority of programs require a bachelor's degree from an accredited university with a minimum cumulative GPA of 3.0, a blend of prerequisite courses, three to four letters of recommendation and a written personal statement. The prerequisite courses required or highly encouraged by these programs typically include, but are not limited to, advanced genetics, statistics, psychology and biochemistry. An appropriate biochemistry course typically requires prerequisites in chemistry and organic chemistry and an appropriate genetics course typically requires prerequisites in biology. The written personal statement should aim to help the program better understand the applicant's reasoning for pursuing a career in genetic counseling, and their relevant experiences. Previously, the Graduate Record Examination (GRE) was a requirement to apply to most graduate programs, however, prior to and during the ongoing pandemic, this has become an evolving requirement and differs across programs.

Experience that may boost an application but may or may not be considered a requirement includes volunteer experience through crisis counseling, working with individuals with disabilities, laboratory or research experience and shadowing genetic

counselors. Graduate programs recognize that finding genetic counselors to shadow can be difficult, especially due to the current pandemic environment. Therefore, interviewing a genetic counselor in person or remotely is also considered a highly beneficial experience.

Following submission of an application, the applicant will potentially be offered an interview and subsequently participate in the online MATCH platform to ideally place with a graduate program. Unfortunately, the application process remains expensive and has been cited as a major barrier for potential applicants to many allied health professions, including genetic counseling. This barrier is particularly prevalent among minority groups (Mittman & Downs, 2008). This is one of the many reasons why it is vital for the field of genetic counseling to develop new strategies to allow more accessibility in pursuing genetic counseling.

Diversity in the Genetic Counseling Field

Another pressing issue that calls for new recruitment strategies in genetic counseling is the startling lack of diversity within the field. Despite years of discussion on the topic, a lack of diversity is a persistent problem (Mittman & Downs, 2008). The field is predominantly comprised of Caucasian individuals at around 90% according to the 2020 National Society of Genetic Counselors Professional Status Survey (NSGC, 2020). Minority groups including Black or African American (2%), Hispanic (2%), and Asian (5%) individuals are lacking in the genetic counseling demographic. The field is also predominantly female at around 95% (NSGC, 2020). There is evidence that this dissuades male individuals from entering the field (Gerard, 2017).

The efforts by the NSGC to increase diversity within the field date back to the early 1990s. Since then, the NSGC has made several concrete efforts to support and advocate for diversity among genetic counselors. Minority underrepresentation in genetic counseling was first discussed at a conference in 1992 when ethnicities within multiple training programs

were reported. This revelation was followed by the NSGC reporting on the diversity within the field annually in their professional status survey by adding ethnicity to the demographic questions. Career packets that were encouraging of applicants from all backgrounds were then distributed to colleges across the nation. Later that year, the NSGC developed a handbook that ensured training programs addressed accurate and helpful information as a part of their multicultural competencies. In the early 2000s, the Diversity Special Interest Group with NSGC was created and has since started a number of initiatives to increase minority representation amongst genetic counselors including “a minority mentorship project, minority scholarships, a Speaker’s bureau, and monitoring of student and member demographics and ethnographics” (NSGC, 2002). As mentioned previously, despite these many efforts the demographics among this population have not shifted (Oh and Lewis, 2005). The question remains: what are the barriers to increased diversity?

There are many possible reasons for the continued lack of diversity within the field including major concerns such as financial barriers and lack of awareness. Gaining diversity within the field is vital not only for the community of genetic counselors but also for our patient population. There is a stark difference between the minority representation among genetic counselors and their patient population. “US national data indicate that 25% of clinical genetic patients are of racial minority status” compared to a mere 8.6% among genetic counselors (CORN, 1994). Previous studies have noted that even though minority students tend to be less aware of genetic counseling, they are just as likely to show interest in pursuing a career in the field once they are aware of the opportunity (Gerard, 2017). Based on this evidence, awareness of the genetic counseling field is a vital step towards creating a more diverse genetic counseling field.

Undergraduate Advising

An integral component to any undergraduate university is their advising team. Advising in an undergraduate setting can be traced back to 1877, when a team of advisors was first established at Johns Hopkins University (Gordon, 2017). “The role of an advisor is to help guide students through a program of study that results in a degree” (Moody, 2019). Advisors at undergraduate universities aim to help students reach this goal in their respective field of study. Previously, advisors focused solely on helping students sign up for classes and ensure they are meeting all the requirements necessary for the completion of their degree. Studies have shown that this role is evolving to include helping students gain access to resources for their time on campus as well as the future. They are intended to be a “hub of information” and available to students throughout their undergraduate career (Moody, 2019).

Each university is unique in how they build an advising team in terms of type and number of advisors. It is most common for a student to meet with an advisor once a semester, however the frequency is up to the student and/or the university policy, which can vary. Sometimes these advisors will be a faculty member that also dedicates themselves to advising, however more recently this has shifted to become more predominately advising staff whose sole focus is advising. These advisors can take on many roles at a university including within an academic specialty such as biology or mathematics or career advising. Career advising can be general or more specific such as advising for the health professions (Gillipsie. 2012).

Awareness of Genetic Counseling

As a relatively new and emerging field, genetic counseling is largely unknown and/or misunderstood as a profession. Previous studies have identified that the general public, undergraduate students and their undergraduate advisors are largely unfamiliar with genetic counseling (Goldberg et al., 2015 and Gerard et al., 2017).

In 2015, Dena Goldberg measured awareness of and misconceptions about genetic counseling identified in the general public in her study titled *Measuring Awareness and Misconceptions About Genetic Counseling Services and Utilizing TV to Educate*. This survey-based study recruited participants from the general public, disability communities and the new parent population and the majority were reported as Non-Hispanic White and female. Fifty four percent of the participants had heard of genetic counseling, of which “30% had been referred to or had seen a genetic counselor, 25% had read about genetic counseling in the news, 19% had a friend or family member who was referred to or who saw a genetic counselor, 17% had read about genetic counseling on the Internet...” and many had heard of genetic counseling through multiple sources. Of the responses listed in this study for the question “How did you become familiar with genetic counseling?”, through school or an advisor was not listed as a choice. However, of the general public cohort that had heard of genetic counseling previously and listed a response in the ‘other’ category, 21% had heard of the profession in school (Goldberg et al., 2015).

Another study, *Undergraduate Student Perceptions and Awareness of Genetic Counseling*, conducted by Amanda Gerard in 2017 aimed to assess the awareness of genetic counseling in the undergraduate student population. The survey-based study particularly targeted students who may have been interested in the health-related professions by sampling students in science focused undergraduate courses. The survey collected information aimed to “assess subjects’ familiarity with genetic counseling, attitudes regarding aspects of a genetic counseling career, and preferences for obtaining information about the career.” The 34% of participants that reported a major in biology demonstrated more familiarity with the field than those of non-biology related majors (Gerard et al., 2017).

Of the individuals who had heard of genetic counseling (~75%), almost half had only heard of the field but were not familiar at all. The authors found that, “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.” Specifically, the results showed that of the 16 individuals who reported that they originally heard about genetic counseling through a college advisor in this study, one felt very familiar, five felt unfamiliar, and ten felt very unfamiliar (Gerard et al., 2017).

Of note, “viewing more information about genetic counseling during the survey facilitated a change in interest levels for approximately half of the participants.” Overall, this study further highlights the need for increased awareness of genetic counseling in the undergraduate community but particularly among undergraduate advisors (Gerard et al., 2017).

Previous studies

Despite a plethora of previous studies focused on the awareness of genetic counseling among the general public, high school and undergraduate students, and multiple patient populations, there is only one known study that directly addresses undergraduate advisors’ awareness of and confidence advising on the genetic counseling profession (Carroll et al., 2017).

The study, *Digging a little deeper: what do college career advisors know about genetic counseling? What do they want to know?*, conducted in 2017 by Sarah Carroll, surveyed health career advisors in an attempt to assess what they do and do not know about the field of genetic counseling. The survey was restricted to practicing advisors who had reportedly advised on genetic counseling within the last three years (Carroll et al., 2017).

Advisors were surveyed on their knowledge of genetic counseling, specifically the “requirements/qualifications of applying to genetic counseling training programs, the various features of different training programs and the career itself.” (Carroll et al., 2017). Over half

of the respondents had discussed genetic counseling 1-4 times over a three-year span with their students. Additionally, 35% of advisors reported that their students generally initiated the discussion of genetic counseling. Of these respondents, only ten percent felt extremely or very confident in discussing genetic counseling as a possible career with their students and only a slightly larger percentage (17%) felt extremely or very confident in discussing the requirements/qualifications for applying to graduate programs in genetic counseling. More than half of the respondents reported no confidence at all in discussing these requirements. The study found a significant correlation between a few aspects of the advisor themselves and their confidence advising on genetic counseling including number of students previously advised, years of advising experience, and the advisors' own personal interaction with a genetic counselor, genetic counseling student, or genetic counseling training program (Carroll et al., 2017).

The study also gathered information on the resources that were most beneficial for advisors seeking more information on genetic counseling including the NSGC website as well as contact with a genetic counselor or genetic counseling student, a fellow colleague, a knowledgeable family member or a medical professional. These proposed beneficial resources were considered when designing the current study (Carroll et al., 2017).

Even though the majority of advisors in Carroll et al.'s study were not familiar with or comfortable discussing the genetic counseling field with their students, over half of the respondents stated interest in learning more about genetic counseling and what the training and profession entails. The author believes this "indicated that advisors are a highly motivated population in terms of learning more about the genetic counseling career path." (Carroll et al., 2017). A document including a list of resources that the author compiled based on expected benefit for those advising on genetic counseling was distributed to all those that completed the survey. Of note by the author, there was no response from the participants on

the benefit of this list of resources on their advising. Therefore, it was suggested that future studies might include a pre- and post-survey analysis to compare the effect that an informational intervention has on this population (Carroll et al., 2017).

This proposal by Carroll et al. (2017) ignited the flame for this current study, which aims to grow on the foundation that was laid by Sarah Carroll and subsequently aid the genetic counseling community in gaining additional insight into this cohort of undergraduate advisors.

Study Significance

It is apparent that awareness of genetic counseling is lacking particularly in the undergraduate advising community. These advisors may be the first and potentially only individuals to have the opportunity to educate and inform undergraduate students about the profession. As previously outlined, the field is in need of diversification and this study has the potential to greatly increase awareness and subsequently increase recruitment of a more diverse and robust population of future genetic counselors. This study will ideally raise awareness of the field, especially among this community, and help genetic counseling take an important step towards this goal.

Study Aims

This study aims to assess the comfort level of advisors in an undergraduate setting on advising about genetic counseling. By utilizing an intervention in the form of a short informational video, which will be detailed below, the study plans to not only raise this cohort's comfort level in advising students that initiate the conversation about genetic counseling, but also increase their awareness of the type of student that may be a good fit for the field so that they may identify these students themselves. This will ideally broaden the group of students that is advised on the field, especially those that are in the career decision making process and may have been otherwise unfamiliar with genetic counseling. The use of

an intervention, in the form of an informational video clip, is expected to increase the comfort level of advisors on advising undergraduate students on genetic counseling.

METHODS

Institutional review board (IRB) approval was obtained from the University of California, Irvine through a self-determination process. The lead investigator and faculty sponsor (thesis committee chair) reviewed and signed this document per university requirements.

Emails were drafted directly to undergraduate advisors (Appendix A) and distributed between January 4th and April 9th, 2021. These advisors were identified based on their title listed on their university's website. The email address listed with their title was utilized to administer the survey. The email subject was titled "Survey Opportunity for Undergraduate Advisors" and the body of the email introduced the potential participant to a University of California, Irvine graduate student conducting a survey. A link to the survey was included in the body of the email. This email in its entirety can be seen in Appendix A.

The same email was also distributed to the members of the National Association of Advisors for the Health Professions (NAAHP) through their email listserv. The NAAHP consists of approximately 1200 members and serves as a resource for the professional development of health professions advisors. Prior to distribution, this survey was discussed amongst the NAAHP research committee and assessed based on their guidelines. The guidelines included the relevance of the content and scope of the project, the timing of the distribution, and the lack of advertisement of a particular program. Lastly, there was an agreement to publish an article in the journal *The Advisor*, which is a publication through the NAAHP available only to their members.

The survey was available to each participant on any electronic device available to them by clicking the provided link. The survey was estimated to take the participants up to 20 minutes to complete including the viewing of an approximately 7-minute video. Upon

completion, the participants were given access to a list of resources as well as the informational video viewed during the survey (Appendix C) via a separate online link.

Participants

Individuals were eligible to complete the survey if they were 18 years or older, spoke English, and were a currently employed or retired undergraduate advisor in the United States. Eligible undergraduate advisor positions included academic (in any department), health career or general career advisors. Those advisors who were not currently or formerly employed by an undergraduate university were excluded from the study.

Data Collection: The Survey

The survey instrument was designed to assess participants' comfort advising on genetic counseling and how that comfort level changed following the viewing of an informational video intervention. Study data were collected and managed using REDCap electronic data capture tools hosted at the University of California, Irvine (PA Harris et al., 2019). REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies, providing 1) an intuitive interface for validated data capture; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for data integration and interoperability with external sources. The survey was piloted with genetic counseling graduate students and family and friends of the lead researcher to assess the functionality of, and time needed to complete, the survey. No individuals who piloted the survey were undergraduate advisors themselves. Following this pilot, revisions were completed, and the survey was finalized. The survey was administered between January 2021 and April 2021.

The survey consisted of a series of 54 questions including multiple choice, true/false, "check all that apply," and open-ended questions. These questions collected information

including demographics, prior awareness of and experience advising on genetic counseling, self-reported confidence level, knowledge of the genetic counseling profession and graduate program requirements and demographics of students advised. The survey instrument in its entirety can be seen in Appendix B.

Demographics

The 13 demographic questions collected data on gender identity, age, employment status, type of university, type of advisor, bachelor's degree held, participation in career fairs and whether there is a genetic counseling graduate school or special interest group at the university at which the advisor is employed.

Prior awareness and experience advising on genetic counseling

The 8 questions that were asked in the pre-survey aimed to understand the participant's awareness of genetic counseling prior to the video intervention and to gather information on the participant's prior experience advising on genetic counseling, if any.

Self-reported confidence level and scored knowledge: before and after intervention

The 13 knowledge questions that were included in both the pre- and post-survey assessed the prior knowledge that the advisor had about the genetic counseling profession and the application process to genetic counseling graduate programs as well as how that knowledge changed following the viewing of an informational video intervention. The questions were divided into a group of questions aimed at assessing knowledge of the profession and a second group of questions aimed at assessing knowledge of the application process for genetic counseling graduate programs. Firstly, the participants were asked to self-report their confidence level on the genetic counseling profession and the application process to genetic counseling graduate programs respectively. Then they were asked to answer the knowledge questions. The questions regarding the profession included true/false/unsure and multiple choice, assessing knowledge of specialties within the field, requirements to practice,

scope of practice, length of training, role of pregnancy termination in the field, and gender identity. The questions about the graduate program requirements included true/false/unsure, multiple choice, and fill in the blank, assessing knowledge of the number of training programs, undergraduate major requirements, and shadowing expectations. The 12 questions asked in the pre-survey and the post-survey were identical.

Benefit of Informational Video Intervention

Three additional questions were asked in the post-survey following the viewing of the video intervention aiming to understand if and how the participants would use the information provided in the video in future advising sessions and if it would increase the total number of students with which they have discussed the field.

Open ended questions

There were two open ended questions asked in the survey. One was included in the knowledge questions but was not scored based on correctness (What would you suggest to a student as relevant volunteer experience for a graduate program in genetic counseling application?). The final question asked of participants aimed to understand the demographics of the students they previously advised or plan to advise, particularly on the field of genetic counseling.

Following the completion of the survey, the advisor was given access to a list of resources via an online link (Appendix C). This list of resources was created as part of this project and aimed to include the most helpful genetic counseling related resources for the undergraduate advisors' use with their students. The advisor was also given access to the informational video that was viewed in between the pre- and post-survey.

Data Analysis

The data was analyzed using IBM SPSS Statistics 25 software and Microsoft Excel Version 16.48 for frequencies of responses as well as for associations and correlations using

Chi-squared analysis and univariate correlation analysis. Statistical significance was determined based on a p-value of 0.05 for all associations. Nominal significance levels are reported and were not adjusted for multiple comparisons. To determine response rate, NAAHP was inquired about the number of members they currently house and the number of emails distributed directly to advisors by the lead researcher was counted.

The pre- and post-survey knowledge responses were coded based on correctness (1 for correct answer, -1 for incorrect answer, 0 for unsure). Each advisor was then given a score for the pre- and post-survey separately based on the sum of their coded responses. A paired sample t-test was performed to determine the mean difference between the pre- and post-test scores for all participants. A univariate analysis (ANOVA) was conducted for each subgroup which was used as the fixed factor and the mean difference was used as the dependent variable. If the participant listed a response that appropriately answered the question, they were given a score of 1. If the participant listed a response that did not appropriately answer the question, they were given a score of -1. If the participant did not respond to the question or expressed uncertainty in their response, it was implied that they were 'unsure', and they were given a score of 0.

To identify themes from the final open-ended question regarding student demographics, the lead researcher read each response and identified some key words and phrases that were mentioned by multiple participants. If four or more participants' responses from either the pre- and/or post-survey mentioned the same key word or phrase, it was identified as a repeated phrase by the lead researcher.

RESULTS

In total, 1131 advisors were contacted to participate via direct email from the lead researcher. Every member of the NAAHP was also invited to participate, which consists of 1200 members. Some of the individuals contacted may have received emails both directly from the lead researcher and from the NAAHP due to the overlap of health career advisors. However, it is impossible to distinguish these individuals based on the anonymity of the survey design. One hundred and three individuals opened the survey, and sixty-seven participants fully completed both the pre- and post-survey. One additional participant completed only a portion of the survey. This corresponds to at least 5% response rate based on those that opened the survey and at least 3% response rate for those that completed the survey in its entirety. Due to the overlap identified above, it is possible that these response rates could have been higher but again this cannot be determined.

Demographics

Most participants were female (79%) with the remaining gender identity frequencies listed in *Table 1*. The ages of the participants were well distributed as follows: 25% 18-35 years, 41% 36-50 years, 29% 51-65 years, and 3% over 65 years. Two percent did not report their age.

Over 97% of participants reported to be currently employed as an advisor. Most participants, 62%, reported being currently employed by a university with more than 10,000 students, with the remaining employed by a university size as seen in *Table 1*. Approximately 91% of advisors are employed by a university that is considered liberal arts, while only 3% reported being employed by a university that is considered technical. Sixty eight percent of participants reported being employed by a public university and 30% by a private university, with 2% not reporting. Forty one percent of participants are responsible for advising 50-300

students, 28% are responsible for advising 301-500 students, 27% are responsible for advising more than 500 students, and 4% are responsible for advising less than 50 students.

Fifty percent of participants identify as an academic advisor, 43% identify as health career advisors, and 7% identify as general career advisors. Of the participants, 60% held a Bachelor of Science, 37% held a Bachelor of Arts, 2% held a Bachelor of Fine Arts, and 1% did not report.

Approximately 70% of individuals reported that there is a genetic counseling graduate program at the University at which they are employed. The remaining either did not have a genetic counseling graduate program present at their university or were unsure as seen in *Table 1*.

The majority of participants, 59%, reported that there is not a genetic counseling special interest group (SIG) at the University at which they are employed. Only 4% of participants reported that there was a SIG present at the University and the remaining were unsure as seen in *Table 1*.

Lastly, slightly more than half of the participants (56%) reported previously participating or planning to participate in a career fair at their university (*Table 1*).

Table 1 Demographics of Participants

		n out of 68	%
Age	18-35	17	25
	36-50	28	41
	51-65	20	29
	Over 65	2	3
	Not reported	1	2
Gender Identity	Female	54	79
	Male	10	15
	Transgender Male	1	2
	Gender non-conforming	1	2
	An identity not listed	1	1
	Prefer not to disclose	1	1
Employment Status	Currently employed as an advisor	66	97
	Previously employed as an advisor	2	3
University size	Less than 3,000	10	16
	3,000-10,000	16	24
	More than 10,000	42	62
University type I	Liberal Arts	62	91
	Technical	2	3
	Not reported	4	6
University type II	Public	46	68
	Private	20	31
	Not reported	1	2
Students responsible for advising	Less than 50	3	4
	50-300	28	41
	301-500	18	27
	More than 500	19	28
Advisor type	Academic	34	50
	Health Career	29	43
	General Career	5	7
Bachelor's degree held	Bachelor of Science	41	60
	Bachelor of Arts	25	37
	Bachelor of Fine Arts	1	2
	Not reported	1	1
Genetic Counseling	Yes	16	24
Graduate Program Present at University?	No	48	70
	Unsure	4	6
Genetic Counseling Special Interest Group (SIG) Present at University?	Yes	3	4
	No	40	59
	Unsure	25	37
Participation in Career Fair?	Yes	38	56
	No	30	44

Additionally, of those participants that identified as academic advisors the department within which they reside in can be seen as listed in *Table 2*.

Table 2 Academic Advisor Demographics

		n out of 34
Department within academic advisors reside	All	1
	Arts & Sciences; Mathematics	1
	Biochemistry	1
	Biochemistry, Chemistry	2
	Biological Science	1
	Biology, Theater, Transfer	1
	Business	1
	College of liberal arts	1
	College of science and engineering	1
	College of Sciences and College of Health Sciences	1
	College wide advising for Undergraduates	1
	Community & Environmental health	1
	Computer science, Engineering and Informatics	2
	Education and human sciences	1
	General	1
	Genetics	1
	Health	1
	Health professions	1
	Liberal Arts	1
	Natural science/exercise science	1
	Physics	1
	Psychology	1
	Speech, Language and Hearing Sciences	1
	Undeclared Arts and Sciences	1

Prior knowledge of and prior experience advising on genetic counseling

Ninety percent (n=61) of participants had previously heard of genetic counseling prior to completing this survey, while only 9% (n=6) had not heard of genetic counseling prior to taking the survey, and 1% (n=1) did not report (*Figure 1*).

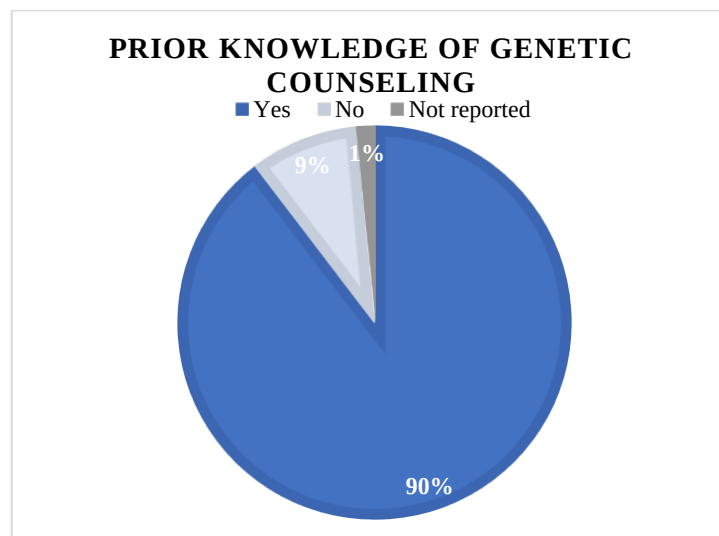


Figure 1 Participants' responses to the survey question "Have you heard of genetic counseling prior to this survey?"; n=68 participants.

Of the 61 participants that had heard of genetic counseling prior to completing the survey, 25 heard about the profession through a student who brought it up to them in an advising session, 13 through a personal experience, 12 through an academic article, 6 through a work experience, 3 through another source, and 2 through a media source (*Table 3*).

Table 3 Participants with prior knowledge of genetic counseling's response to check all that apply survey question "Where did you hear of genetic counseling?"

First heard of genetic counseling	n
A Student brought it up to me	25
Through a personal experience	13
Through an academic article	12
Through a work experience	6
Other	3
Through a media source	2

Most participants, 75% (n=51), had prior experience advising on genetic counseling, while 23% (n=16) had no prior experience advising a student on genetic counseling, and 2% (n=1) did not report (*Figure 2*).

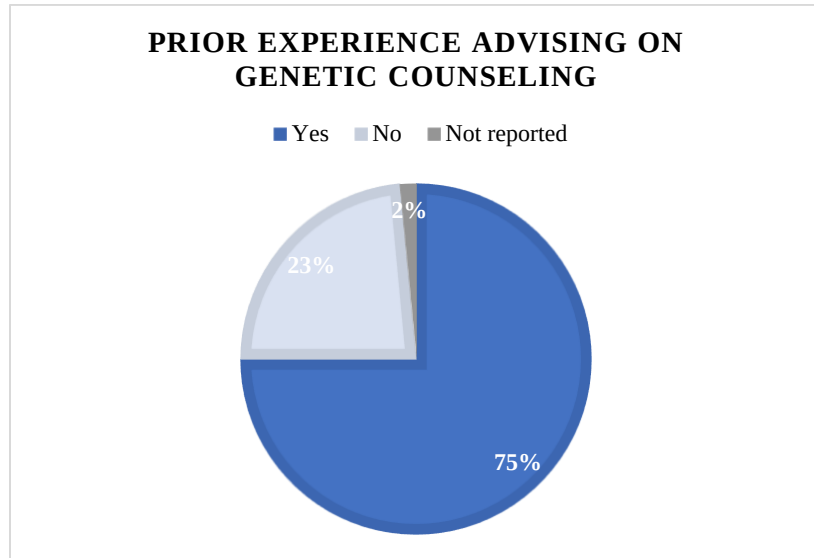


Figure 2 Participants' responses to "Have you ever advised on genetic counseling?"; n=68 participants.

Of the 51 participants that reported prior experience advising on genetic counseling, 8% advised 0-1 students, 17% advised 2-3 students, 12% advised 4-5 students, 8% advised 6-9 students, 55% advised 10 or more students (*Table 4*).

Table 4 Participants with prior experience advising on genetic counseling reported number of students advised

# of students advised	n	%
0-1	4	8
2-3	9	17
4-5	6	12
6-9	4	8
10 or more	28	55
Total	51	100

Resources

In the pre-survey, the participants that had advised on genetic counseling previously (n=51) reported the resources that they had provided students. Twenty-five participants reported suggesting the National Society of Genetic Counselors (NSGC) website, 32 reported suggesting the individual genetic counseling graduate program websites, 13 reported suggesting the Accreditation Council of Genetic Counselors (ACGC) website, and 9 reported using another website (*Table 5*).

Table 5 Resources reported to be used for advising on genetic counseling by participants prior to the video intervention and resources participants will likely use following the video intervention

	Pre-survey responses*	Post-survey responses*
Resource	n	n
National Society of Genetic Counselors (NSGC) Website	25	43
Accreditation Council of Genetic Counselors (ACGC) Website	13	34
Genetic Counseling Graduate Program Websites	32	45
Other Website	9	4
Pamphlet or paper resource	2	10
Referral to local genetic counselor	13	24
Other Resource	7	4

*Note: The numbers in each column sum to more than the total sample size (n=67) because some respondents indicated that they referred advisees to more than one resource.

The ‘other’ websites reported by these participants were:

- Explorehealthprofessions.org, mentioned by three participants
- NAAHP.org
- <https://agcpd.org/prospective-students/>
- <https://www.dana-farber.org/cancer-genetics-and-prevention/our-team/>
- Career Services
- O*NET
- Local state-schools academic program site

Two participants reported suggesting a pamphlet or paper resource, 13 reported making a referral to a local genetic counselor, and 7 reported providing another resource. The ‘other’ resources reported by these participants were:

- Director of the Master's in Genetic Counseling program, program on our campus
- Genetic Counseling Certificate Program
- We have "pre-health" advisors who discuss all health-related careers with students
- We have a genetic counseling program; I help them find employment; resources are employment focused
- Resources housed within my Canvas site

In the post-survey, all participants reported what resources they were likely to use following the video intervention. Refer to *Table 5* for the distribution of resources used among participants. The ‘other’ websites reported by these participants were:

- Explorehealthcareers.org
- NAAHP/NEAAHP resources

Ten participants reported a pamphlet or paper resource, 24 reported a referral to a local genetic counselor, and 4 reported another resource. The values can be seen in *Table 5*. The ‘other’ resources reported by these participants were:

- The video used as an intervention, mentioned by three participants
- Family known to have child/children who have used genetic counseling, or personal genetic counseling

The participants who had previously provided resources to students when advising on genetic counseling reported where they obtained these resources in a check all that apply question (*Table 6*). Eight participants reported a training session, 9 reported at a seminar, 37 reported online, 2 reported from a previous student, and 10 reported other sources which included:

- Introduced to her in our building
- From program on our campus
- Prior knowledge
- My son has hemophilia A
- I googled it
- Counselor that I know personally

- Contact with health care professional
- Meetings with program directors
- NAAHP listserv and conferences
- My own research.

Table 6 Participants who had previously provided resources to students when advising on genetic counseling and where they obtained those resources

Where the advisor obtained the resources previously used*	n out of 51
During a training session	8
At a seminar	9
Online	37
From a previous student	2
Other	10

*Note: This was a check all that apply survey question asked of those participants who had previously advised on genetic counseling. It was administered in the pre-survey prior to the participant's viewing of the video intervention.

Knowledge based questions

Sixty-seven total participants completed the pre- and post-survey. The highest score that a participant could have received with all correct answers to the knowledge questions regarding the genetic counseling profession was 9 and for the genetic counseling graduate program requirements was 3, for a highest possible total score for all knowledge questions of 12.

The breakdown of participants based on correctness for each knowledge question can be seen in *Table 7*. The highest number of correct responses recorded in the pre survey questions was for question 8 ((True/False) Genetic counselors can be of any gender identity.) at 65 of a possible 67 correct responses. The question that demonstrated the highest improvement (*Table 7*) among participant responses, meaning the number of correct responses in the post-survey responses minus the number of correct responses in the pre-survey responses, was question 7 ((True/False) Every genetic counselor must have another medical professional present in all sessions they conduct with a patient.) with an increase of 44 in the number of correct responses. The remaining details on the breakdown of responses to the knowledge questions can be seen in *Table 7*.

Table 7 Breakdown of Participants based on Correctness of Responses to Knowledge Questions

Question**	Pre-survey			Post-survey			Improvement*
	C	I	U	C	I	U	
1. (T/F) Genetic counselors work with preconception and prenatal (those that are planning to become pregnant or are currently pregnant) patients only.	44	14	9	51	9	7	7
2. (T/F) A genetic counselor must complete a medical degree (e.g. MD or DO) to practice genetic counseling.	58	3	6	65	1	1	7
3. (T/F) If an individual currently receives counseling from a licensed therapist, it will never be necessary for that individual to see a genetic counselor.	63	0	4	65	1	1	2
4. (T/F) Genetic counselors assist couples to select for specific aesthetic traits such as eye color or height to create the most desirable offspring.	51	4	12	56	3	8	5
5. How many years does it typically take to complete a genetic counseling graduate program? 2	49	17	1	62	4	1	13
6. (T/F) All genetic counselors must support pregnancy termination.	48	2	17	51	2	14	3
7. (T/F) Every genetic counselor must have another medical professional present in all sessions they conduct with a patient.	15	1	15	59	5	3	44
8. (T/F) Genetic counselors may be of any gender identity.	65	0	2	65	1	1	0
9. (T/F) Some genetic counselors do not work directly with patients, but rather work in a laboratory setting.	34	8	25	49	5	13	15
10. How many accredited graduate programs in genetic counseling are there in the United States and Canada? About 50	30	14	23	60	2	4	30
11. (T/F) A prospective genetic counseling graduate student must have a bachelor's degree in science.	41	13	13	50	8	9	9
12. (T/F) All genetic counseling graduate programs require prospective students to have experience shadowing at least one genetic counselor before applying.	16	20	31	43	12	12	27

*Improvement= # correct in post-survey - # correct in pre-survey; C = Correct, I = Incorrect, U = Unsure, T/F = True/False

**Correct answer to each question in bold

Each participant was given a pre-survey and post-survey score based on correctness of responses (Appendix F) as described in the Methods section. *Figures 3-5* depict the pre- and post-survey scores for all participants.

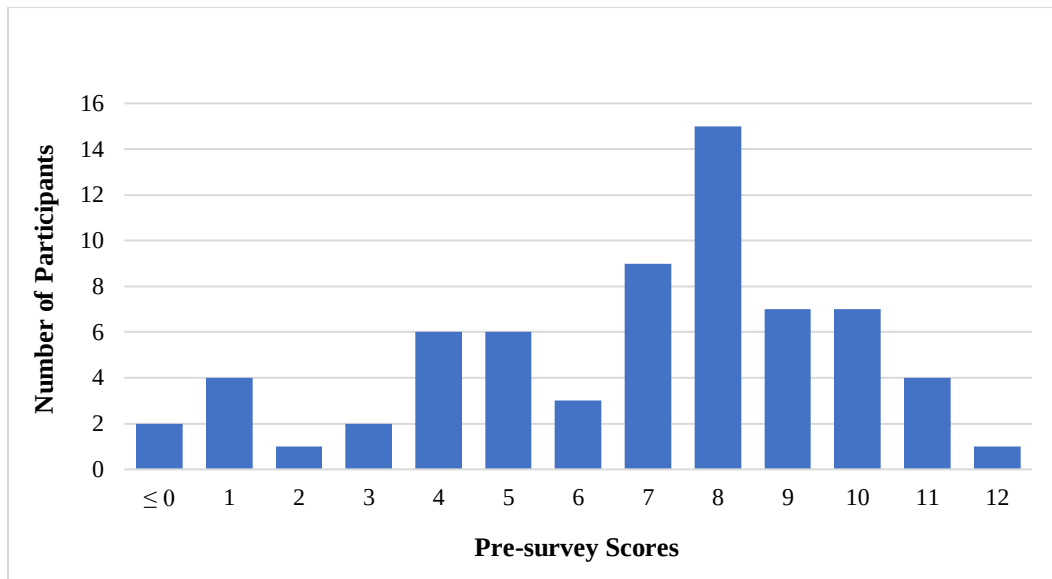


Figure 3 Histogram of Participants' Pre-Survey Scores. n=67 participants. Participants were each given scores based on the correctness of their responses to the 12 knowledge questions in the pre-survey. The highest possible score that a participant could have received is 12. All scores were whole numbers only. Each column depicts the number of participants with scores as listed on the X-axis.

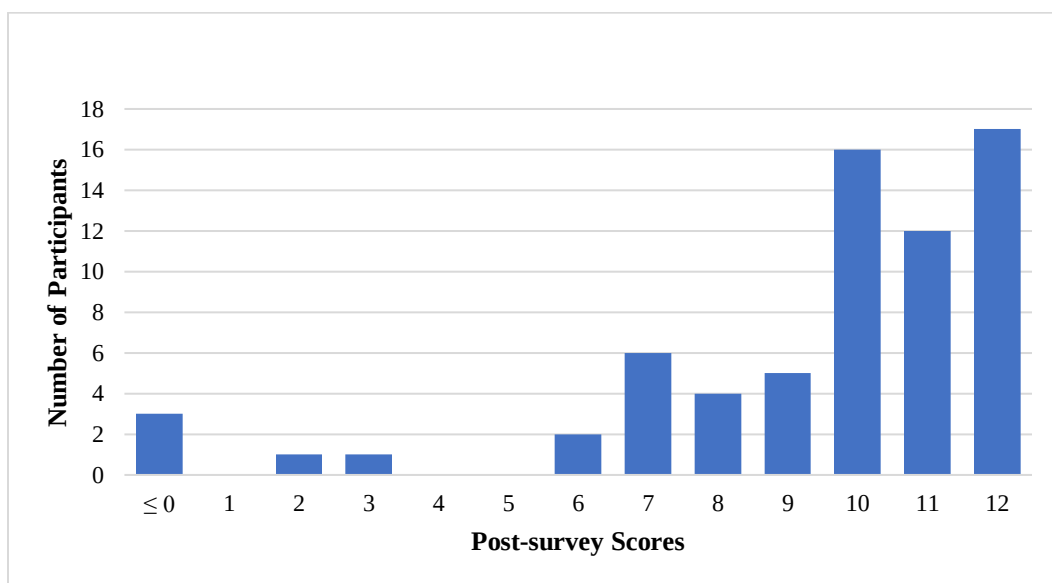


Figure 4 Histogram of Participants' Post-Survey Scores. n=67 participants. Participants were each given scores based on the correctness of their responses to the 12 knowledge questions in the post-survey that were identical to those in the pre-survey. The highest possible score that a participant could have received is 12. All scores were whole numbers only. Each column depicts the number of participants with scores as listed on the X-axis.

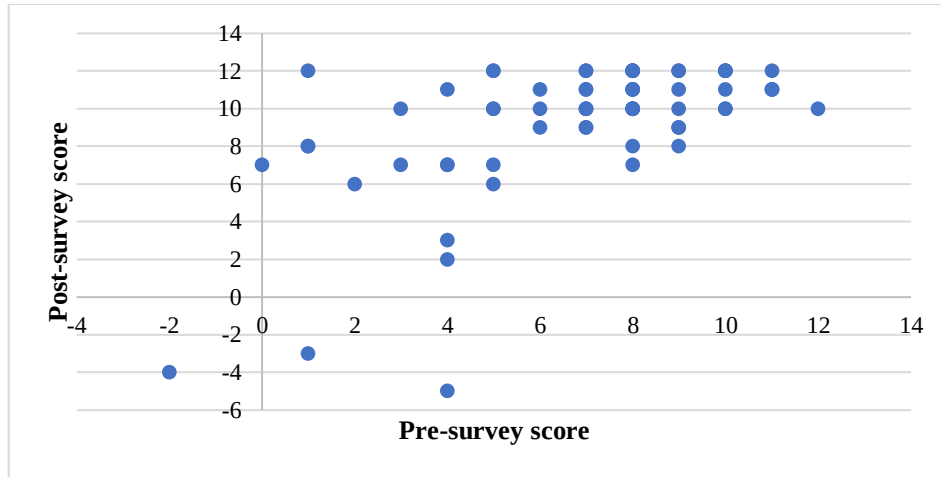


Figure 5 Scatter Plot of Pre- vs Post-Survey Scores for All Knowledge Questions. n=67 participants. Each dot represents one or more participants' scores for the pre- and post-survey.

The mean score for participants' responses to these knowledge questions regarding the genetic counseling profession significantly increased by 1.2 points from pre-survey (6.3) to post-survey (7.5). This difference is statistically significant based on a paired-samples t-test ($T = 5.1$, 66 d.f., $p < 0.0001$; Table 8).

The mean score for participants' responses to knowledge questions regarding the genetic counseling graduate programs significantly increased by 1.3 points from pre-survey (0.5) to post-survey (1.8). This difference is statistically significant based on a paired-samples t-test ($T = 5.8$, 66 d.f., $p=0.02$; Table 8).

These values are also depicted in Figure 6.

Table 8 Pre- and Post-Survey Mean Scores for All Participants based on Knowledge Questions

	Knowledge questions about genetic counseling profession				Knowledge questions about genetic counseling graduate program requirements			
	Mean	n	SD*	p-value**	Mean	n	SD*	p-value**
Pre-survey score	6.3	67	2.3	<0.0001	0.5	67	1.5	0.02
Post-survey score	7.5	67	2.4		1.8	67	1.5	

*SD = Standard Deviation from the Mean

**p-value obtained from paired samples t-test

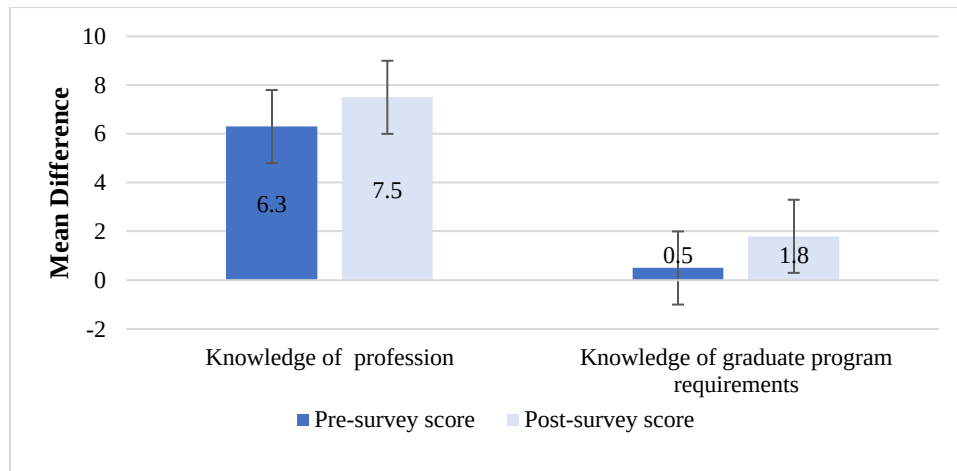


Figure 6 Mean Scores for Pre-Survey vs Post-Survey based on Knowledge Questions Regarding Genetic Counseling Profession. Difference = post survey score - pre survey score.

Confidence Level

Table 9 and Figure 7 show the comparison of participants' whose confidence level advising on genetic counseling was reported as not at all confident (n=12,17), somewhat unconfident (n=25,28), somewhat confident (n=13,17), or very confident (n=5) with respect to the difference (after viewing the video intervention) in their knowledge scores. The four groups did differ significantly in the magnitude of the change in knowledge score for knowledge of the profession ($p < 0.0001$). The four groups did not differ significantly in the magnitude of the change in knowledge score for knowledge of genetic counseling graduate program requirements ($p = 0.33$).

Table 10 indicates which participants reported the same confidence level regarding the genetic counseling profession and the graduate programs requirements and which participants reported differing confidence levels for each. Of those that reported a different confidence level, Table 10 also reports which aspect of genetic counseling they were more confident advising on.

Table 9 Self-reported Confidence level and Mean Score Difference based on Knowledge Questions about Genetic Counseling Profession

Confidence level	Knowledge questions about genetic counseling profession				Knowledge questions about genetic counseling graduate program requirements			
	Mean Difference*	SD*	n	p-value*	Mean Difference*	SD*	n	p-value*
Very Confident	0.2	1.0	5	<0.0001	0.2	1.8	5	0.33
Somewhat Confident	0.9	1.7	25		1.2	1.6	28	
Somewhat Unconfident	0.9	1.1	13		1.8	1.8	17	
Not at all Confident	2.2	3.4	12		1.2	1.2	17	

*Difference = Post-survey score – pre-survey score; SD = Standard Deviation from the Mean; p-value obtained from univariate analysis

Table 10 Difference in self-reported confidence levels amongst participants between two question groups

Confidence level	n	%
Higher for profession	21	31
Higher level for graduate program requirements	13	49
Same for both groups	33	20

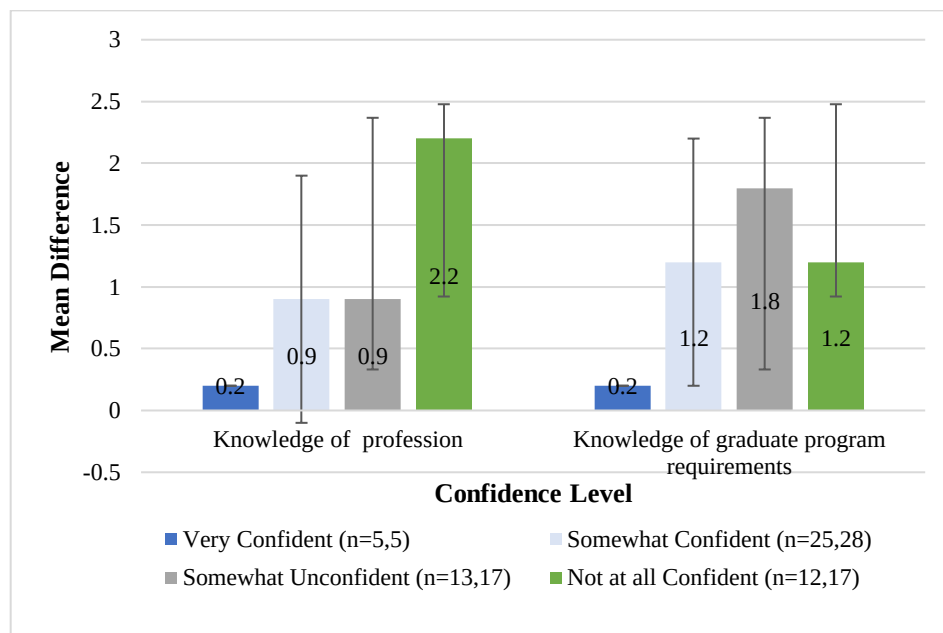


Figure 7 Confidence Level and Mean Difference based on Knowledge Questions regarding Genetic Counseling Profession.

Difference = post-survey score – pre-survey score. The number of participants in each category is indicated by the n in parentheses. The two numbers listed indicate the self-reported confidence level advising on the genetic counseling profession and the genetic counseling graduate program requirements respectively. Mean difference was significant for knowledge of the profession ($p < 0.0001$) and not significant for knowledge of the graduate program requirements ($p = 0.33$).

Advisor Type

Table 11 and Figure 8 show the comparison of participants who identify as health career advisors ($n = 33$), academic advisors ($n = 29$), or general career advisors ($n = 5$) with

respect the difference (after viewing the video intervention) in their knowledge scores. The three groups did not differ significantly in the magnitude of the change in knowledge score for either knowledge of the profession ($p=0.63$) or knowledge of genetic counseling graduate program requirements ($p=0.53$).

Table 11 Advisor Type and Mean Score Difference based on Knowledge Questions

Knowledge questions about genetic counseling profession					Knowledge questions about genetic counseling graduate program requirements			
Advisor Type	Mean Difference*	SD*	n	p-value*	Mean Difference*	SD*	n	p-value*
Academic	1.4	2.3	29	0.63	1.0	1.6	29	0.53
Health Career	0.9	1.7	33		1.5	2.0	33	
General Career	0.5	0.7	5		1.6	1.3	5	

*Difference = Post-survey score – pre-survey score; SD = Standard Deviation from the Mean; p-value obtained from univariate analysis

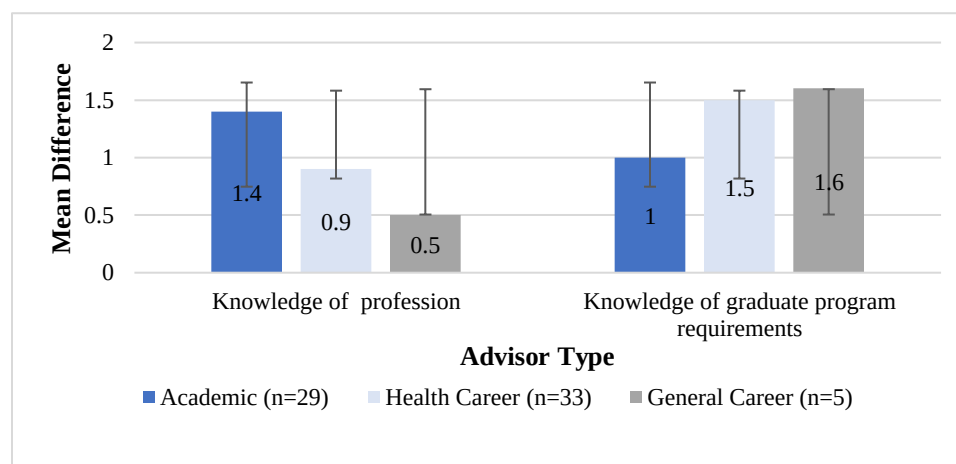


Figure 8 Advisor Type and Mean Difference in Pre- and Post-Survey Scores. Difference = post-survey score – pre-survey score. The number of participants in each category is indicated by the n in parentheses. Mean differences were not significant for either knowledge of the profession ($p=0.63$) or knowledge of the graduate program requirements ($p=0.53$).

University Size

Table 12 and Figure 9 show the comparison of participants who are employed by a university that houses more than 10,000 students ($n=43$), 3,000-10,000 students ($n=15$), or less than 3,000 students ($n=9$) with respect the difference (after viewing the video intervention) in their knowledge scores. The three groups did not differ significantly in the magnitude of the change in knowledge score for either knowledge of the profession ($p=0.86$) or knowledge of genetic counseling graduate program requirements ($p=0.55$).

Table 12 School Size and Mean Score Difference based on Knowledge Questions about Genetic Counseling Profession

Knowledge questions about genetic counseling profession					Knowledge questions about genetic counseling graduate program requirements			
School Size	Mean Difference*	SD*	n	p-value*	Mean Difference*	SD*	n	p-value*
More than 10,000	1.2	2.0	43	0.86	1.4	1.9	43	0.55
3,000-10,000	1.1	2.2	15		1.4	1.7	15	
Less than 3,000	1.8	1.9	9		0.7	1.2	9	

*Difference = Post-survey score – pre-survey score; SD = Standard Deviation from the Mean; p-value obtained from univariate analysis

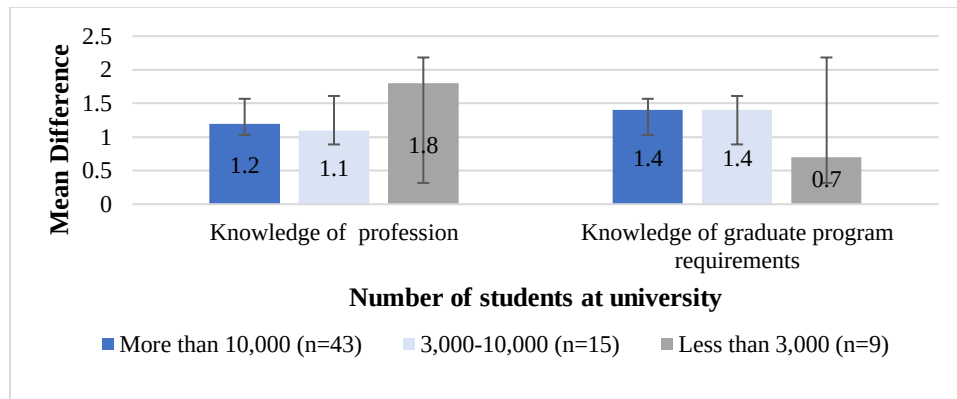


Figure 9 School Size and Mean Difference in Pre- and Post-Survey Scores. Difference = post survey score - pre survey score. The number of participants in each category is indicated by the n in parentheses. Mean differences were not significant for either knowledge of the profession (p=0.86) or knowledge of the graduate program requirements (p=0.55).

University Type

Table 13 and Figure 10 show the comparison of participants who are employed by a public university (n=47) or by a private university (n=20) with respect the difference (after viewing the video intervention) in their knowledge scores. The two groups did not differ significantly in the magnitude of the change in knowledge score for either knowledge of the profession (p=0.42) or knowledge of genetic counseling graduate program requirements (p=0.68).

Table 13 University Type and Mean Score Difference based on Knowledge Questions

University Type	Knowledge questions about genetic counseling profession				Knowledge questions about genetic counseling graduate program requirements			
	Mean Difference*	SD*	n	p-value*	Mean Difference*	SD*	n	p-value*
Public	1.2	1.9	47	0.42	1.4	1.5	47	0.68
Private	1.3	2.2	20		1.2	1.5	20	

*Difference = Post-survey score – pre-survey score; SD = Standard Deviation from the Mean; p-value obtained from univariate analysis

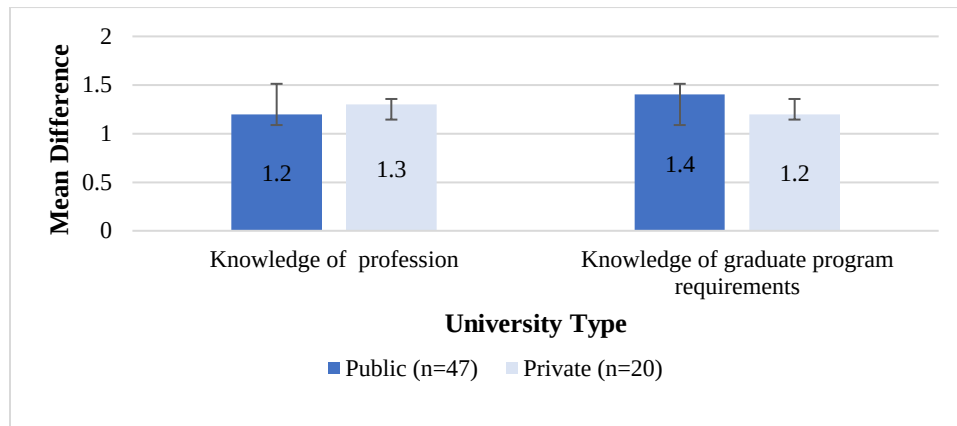


Figure 10 University Type and Mean Difference in Pre- and Post-Survey Scores. Difference = post-survey score - pre-survey score. The number of participants in each category is indicated by the n in parentheses. Mean differences were not significant for either knowledge of the profession ($p=0.42$) or knowledge of the graduate program requirements ($p=0.68$).

Genetic Counseling Program at University

Table 14 and Figure 11 show the comparison of participants who are employed by a university that has a genetic counseling program ($n=15$) or a university that does not ($n=48$) with respect to the difference (after viewing the video intervention) in their knowledge scores. The two groups did not differ significantly in the magnitude of the change in knowledge score for either knowledge of the profession ($p=0.83$) or knowledge of genetic counseling graduate program requirements ($p=0.38$).

Table 14 Genetic Counseling Program at University and Mean Score Difference based on Knowledge Questions

Genetic Counseling Program at University	Knowledge questions about genetic counseling profession				Knowledge questions about genetic counseling graduate program requirements			
	Mean Difference*	SD*	n	p-value*	Mean Difference*	SD*	n	p-value*
Yes	1.4	1.4	15	0.83	1.8	1.8	15	0.38
No	1.5	1.9	48		1.2	1.7	48	
Unsure	0.7	2.4	4		0	2.8	4	

*Difference = Post-survey score – pre-survey score; SD = Standard Deviation from the Mean; p-value obtained from univariate analysis

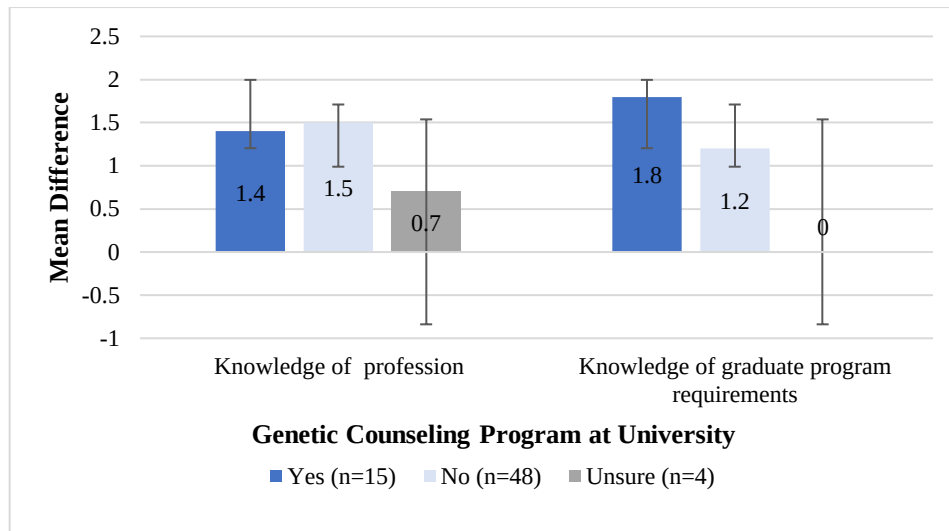


Figure 11 Genetic Counseling Program at University and Mean Difference in Pre and Post Survey Scores. Difference = post-survey score – pre-survey score. The number of participants in each category is indicated by the n in parentheses. Mean differences were not significant for either knowledge of the profession ($p=0.83$) or knowledge of the graduate program requirements ($p=0.38$).

Previous Advising Experience

Table 15 and Figure 12 show the comparison of participants who had previously advised on genetic counseling ($n=47$) or had not previously advised on genetic counseling ($n=20$) with respect the difference (after viewing the video intervention) in their knowledge scores. The two groups did not differ significantly in the magnitude of the change in knowledge score for either knowledge of the profession ($p=0.42$) or knowledge of genetic counseling graduate program requirements ($p=0.58$).

Table 15 Previous Advising Experience on Genetic Counseling and Mean Score Difference based on Knowledge Questions about Genetic Counseling Profession

Previously Advised on Genetic Counseling	Knowledge questions about genetic counseling profession				Knowledge questions about genetic counseling graduate program requirements			
	Mean Difference*	SD*	n	p-value*	Mean Difference*	SD*	n	p-value*
Yes	1.2	1.9	47	0.42	1.4	1.7	47	0.58
No	1.3	2.2	20		1.0	2.0	20	

*Difference = Post-survey score – pre-survey score; SD = Standard Deviation from the Mean; p-value obtained from univariate analysis

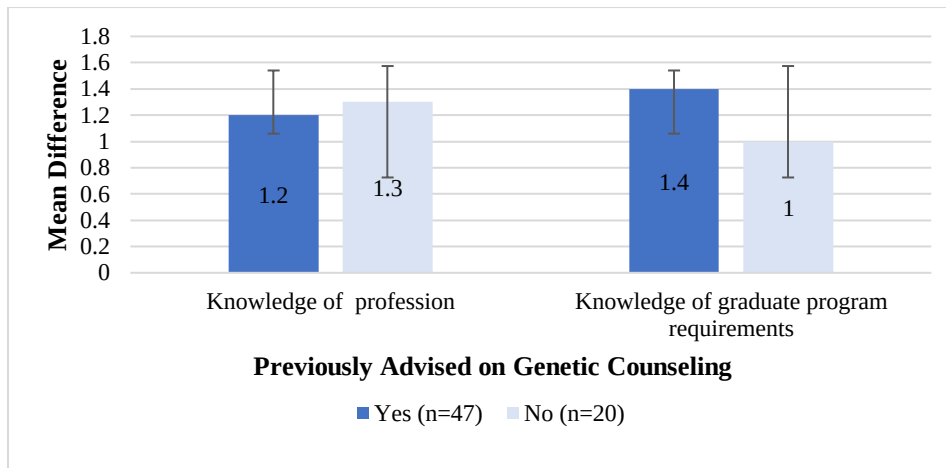


Figure 12 Previous Experience Advising on Genetic Counseling and Mean Difference in Pre- and Post-Survey Scores. Difference = post-survey score - pre-survey score. The number of participants in each category is indicated by the n in parentheses. Mean differences were not significant for either knowledge of the profession ($p=0.42$) or knowledge of the graduate program requirements ($p=0.58$).

Table 16 and Figure 13 show the comparison of participants who had previously advised on genetic counseling ($n=50$) and if the student brought up genetic counseling to them ($n=29$) or they brought up genetic counseling to the student ($n=21$) with respect the difference (after viewing the video intervention) in their knowledge scores. The two groups did not differ significantly in the magnitude of the change in knowledge score for either knowledge of the profession ($p=0.86$) or knowledge of genetic counseling graduate program requirements ($p=0.55$).

Table 16 Who Brought Up Genetic Counseling and Mean Score Difference based on Knowledge Questions

Who Brought Up Genetic Counseling	Knowledge questions about genetic counseling profession				Knowledge questions about genetic counseling graduate program requirements			
	Mean Difference	SD*	n	p-value*	Mean Difference	SD*	n	p-value*
Student brought up	1.1	1.4	29	0.04	1.7	1.7	29	0.07
Advisor brought up	0.7	1.0	21		0.7	2.0	21	

*Difference = Post-survey score – pre-survey score; SD = Standard Deviation from the Mean; p-value obtained from univariate analysis

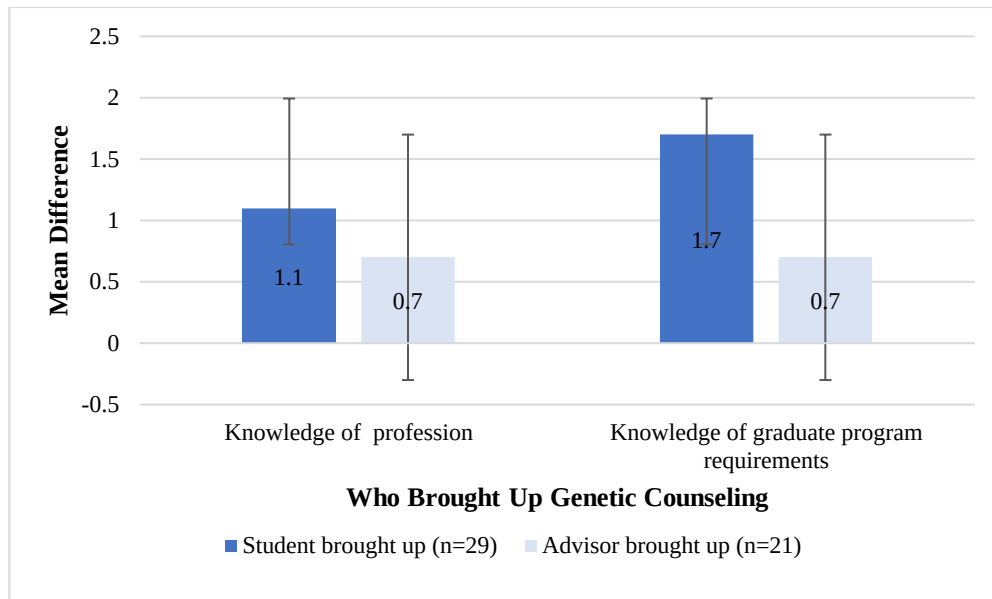


Figure 13 Whether the Advisor brought up Genetic Counseling and Mean Difference in Pre- and Post-Survey Scores. Difference = post survey score - pre survey score. The number of participants in each category is indicated by the n in parentheses. Mean difference was significant for knowledge of the profession ($p=0.04$) and not significant for knowledge of the graduate program requirements ($p=0.07$).

Open ended responses

Repeat responses were identified from the three open-ended questions in this survey. Two of the questions were identical and were repeated in the pre- and post-survey. This was a knowledge question that was not included in the mean scores for the pre- and post-survey (What would you suggest to a student as relevant volunteer experience for a graduate program in genetic counseling application?). Six repeat responses were identified from these responses. In the pre-survey, 16 participants mentioned shadowing/interviewing a genetic counselor, 18 mentioned volunteering for a crisis line, 2 mentioned working with individuals with disabilities, 13 mentioned hospital/clinic volunteer work, 7 mentioned research/laboratory work, and 4 mentioned a form of mentoring in their open-ended response. In the post-survey 16 participants mentioned shadowing/interviewing a genetic counselor, 21 mentioned volunteering for a crisis line, 16 mentioned working with individuals with disabilities, 4 mentioned hospital/clinic volunteer work, 5 mentioned research/laboratory work, and 0 mentioned mentorship in their open-ended response. These values can be seen in *Table 17*. A comprehensive list of the responses to this survey question can be found in Appendix D.

Table 17 Themes of volunteer experience suggestions based on participants' responses to the knowledge question "What would you suggest to a student as relevant volunteer experience for a graduate program in genetic counseling application?"

Volunteer Experience	Pre-survey	Post-survey
Shadowing/Interviewing a Genetic Counselor	16	16
Volunteering for a crisis line	18	21
Working with individuals with disabilities	2	16
Hospital/Clinic Volunteering	13	4
Research/Laboratory work	7	5
Mentorship	4	0

The final survey question required an open-ended response from participants regarding the demographics of the students that they had previously discussed genetic counseling with or plan to discuss with in the future. Five responses were identified that were

mentioned by multiple participants when answering this survey question. Nine participants mentioned ethnicity and in all nine cases indicated that the students with whom they discussed genetic counseling were white. Nine participants mentioned gender and in all nine cases indicated that the students with whom they discussed genetic counseling were female. Six participants mentioned a change in career, 4 of whom mentioned a change directly from “pre-med.” Four participants mentioned undergraduate major, specifically health science or public health majors. Lastly, 4 participants mentioned students with a family member with a genetic disorder. A comprehensive list of the responses to this survey question can be found in Appendix D.

DISCUSSION

This study was unique in that it was the first to assess the baseline comfort level of a broad range of undergraduate advisors and to assess the impact of an informational video intervention with a pre-and post-survey instrument. In previous research, only health career advisors were surveyed and to qualify for the survey they were required to have previous experience advising on genetic counseling. The health career advisors surveyed in this study were identified as an underutilized resource for genetic counseling recruitment and were reported to be in large part not at all confident advising on the field (Carroll et al., 2017).

In the current study, health career advisors were surveyed along with academic and general career advisors and there was no previous experience advising on genetic counseling necessary to participate in the survey. It was hypothesized that the comfort level advising on genetic counseling across undergraduate advisors would be low in the pre-survey and increase in the post-survey following the video intervention.

Across the 67 participants included in the pre- and post-survey analysis, there was a significant increase ($p < 0.001$) of more than one point in the scores for responses to the twelve knowledge questions from the pre-survey to the post-survey (*Figure 2*). Based on this data, it appears that the video intervention increased the advisors' knowledge of both the genetic counseling profession and the graduate program requirements and ideally increased their comfort level advising on the topics in the future. This significant increase in knowledge indicates that distributing information through an informational video format could increase knowledge of genetic counseling in the undergraduate advisor population.

Overall, based on number of correct responses in the pre-survey (*Table 5*), the knowledge questions regarding the genetic counseling profession were more widely understood by advisors prior to the viewing of the information video. There were two

knowledge questions regarding the genetic counseling profession that almost all participants answered correctly prior to the viewing of the video namely questions 3 and 8.

3. (True/False) If an individual currently receives counseling from a licensed therapist, it will never be necessary for that individual to see a genetic counselor.

8. (True/False) Genetic counselors may be of any gender identity.

Two knowledge questions that garnered two of the highest improvement values (number of correct responses in pre-survey minus number of correct responses in post-survey) were questions 10 and 11 regarding the genetic counseling graduate program requirements. These two questions had improvement scores of 30 and 27 respectively (*Table 5*).

10. How many accredited graduate programs in genetic counseling are there in the United States and Canada?

11. (True/False) A prospective genetic counseling graduate student must have a bachelor's degree in science.

However, the knowledge question that garnered the most improvement was question 7 with an improvement of 44.

7. (T/F) Every genetic counselor must have another medical professional present in all sessions they conduct with a patient.

Even though there were only three knowledge questions regarding the genetic counseling graduate program requirements compared to the nine questions regarding the profession, it seems that advisors are particularly lacking in knowledge about the graduate programs due to the significantly lower level of correct responses in the pre-survey.

Knowledge of this aspect of genetic counseling is vital to a successful advising session with students interested in the field, and therefore the lack of knowledge identified in this survey is pertinent to increased student recruitment to the field. As stated, there were also knowledge

questions regarding the genetic counseling profession that revealed large improvement values (*Table 5*), and therefore it remains incredibly valuable to educate this population about the genetic profession.

The subgroup analysis that was conducted highlighted demographics of the advisors surveyed that did or did not play a role in the impact the video made on their apparent knowledge of genetic counseling.

Only 7.4% of participants reported being very confident advising on the genetic counseling profession and the graduate program requirements (*Table 8*) which is similar to what was observed in previous research at 10% (Sarah Carroll). The scores based on the pre- and post-survey responses from this cohort of participants demonstrated the least improvement with a mere 0.2 point increase in post-survey scores for the knowledge of both the genetic counseling profession and the graduate program requirements (*Figure 7*). The data indicates that individuals who began the survey with a high level of confidence had the least to gain from the informational video intervention. On the other hand, the 13 participants (19%) that reported feeling not at all confident advising on the genetic counseling profession had a two-point higher mean difference between the pre- and post-survey scores than those that reported being very confident. Additionally, although not statistically significant, the 17 individuals that were somewhat unconfident advising on the genetic counseling graduate program requirements prior to the video intervention had a 1.6 point higher mean difference between the pre- and post-survey scores than those that reported being very confident (*Figure 7*). The large increase identified among this cohort of advisors illustrates the substantial impact that the video intervention had on those with a low confidence level prior to the survey over those that already felt a high level of confidence. This analysis therefore highlights the importance of targeting those advisors that currently have a low confidence level advising on genetic counseling.

Overall, all three types of advisors, academic, health career, and general career, were similarly impacted by the video intervention. Health career advisors are expected to be confident advising on the medical and allied health professions, however, previous studies have shown that college career advisors discuss genetic counseling significantly less frequently than other health professions (Rogers, 2016). Despite their prior confidence level, all three advisor types seemed to gain knowledge from the video intervention. The results of this study illustrate that all three advisor types, including health career advisors, are positively impacted by the information given in video format as their knowledge increased regarding both the profession and the graduate program requirements.

It was expected that those who did not have previous advising experience on genetic counseling would receive a greater benefit demonstrated by a larger increase in knowledge following the information video intervention. However, this was not the case. The lack of a substantial gap in mean difference between the advisors that had experience previously advising on genetic counseling and those that had not was surprising. The video appeared to equally benefit those that did and did not have previous experience advising on genetic counseling. Of note, it appears that many advisors in this study have advised many students on genetic counseling despite their lack of knowledge on the subject. Of those that had previously advised on genetic counseling, 52% had advised 10 or more students about genetic counseling. As mentioned, this group still greatly benefited from the intervention.

Previous studies identified that “35% of advisors reported that their students generally initiated the discussion of genetic counseling” (Carroll et al., 2017). The current study identified a larger portion of advisors that reported their students initiating the discussion of genetic counseling at 58%. Additionally, there was a significant difference between the pre- and post-survey scores of those advisors that brought up genetic counseling to their students and those that reported that the student brought it up to them. It is likely that advisors who

had brought up genetic counseling to their students in the past have a higher level of confidence advising on the field. Based on these results, this is the case in this population of advisors. It is likely that the participants that reported the student brought up genetic counseling to them had a lower confidence level prior to viewing the video intervention than those that had brought genetic counseling up to their students as a career option.

The number of students present at the university at which the advisor was employed and whether the university was public or private did not appear to have a substantial impact on the mean difference in knowledge scores (*Figures 9 and 10*). Based on this finding, advisors at universities of various sizes and types are likely to gain knowledge and be positively impacted in terms of confidence for future advising sessions by an informational video on genetic counseling.

Whether or not the university at which the advisor was employed housed a genetic counseling graduate program seemed to have a larger impact on those that were confident that the university did or did not than those who were unsure (*Figure 11*). However, there were only 4 individuals that were unsure of this and therefore this point is likely not generalizable. It is expected that an informational video would have a greater impact on those that do not have a genetic counseling graduate program at their university due to limited chance for interaction with a graduate program and therefore the field. This did not prove to be the case in the population surveyed in this study. Once again, all advisors, regardless of the presence of a graduate program in genetic counseling at their university, are likely to benefit from additional information on genetic counseling.

Table 4.1 illustrates that participants were much more likely to utilize genetic counseling resources during advising sessions after viewing the video intervention, especially the National Society of Genetic Counselors and Accreditation Council of Genetic Counseling websites as well as referrals to local genetic counselors. The majority of individuals reported

utilizing the genetic counseling graduate program websites in the pre- and post-survey responses. These were all recommended resources from the video indicating its positive impact. The genetic counseling program websites are particularly important for students applying to genetic counseling graduate programs as they are all unique in their requirements and expectations. Even though many advisors reported use of these websites previously, 13 additional participants reported plans to use them in the future and it is likely that the video solidified the importance and reasoning behind utilizing this resource with students even if the advisor already had experience with these websites in the past. Additionally, the data signifies that the video was engaging, and the participants retained specific information from the video that they anticipated to be helpful in future advising sessions.

The first two open-ended questions in this survey were identical in the pre- and post-survey asking: What would you suggest to a student as relevant volunteer experience for a graduate program in genetic counseling application? A few of the suggested volunteer experiences were similar from the pre- to post-survey responses including shadowing or interviewing a genetic counselor and volunteering for a crisis line. These are both great suggestions for a student who is considering applying to a genetic counseling graduate program and therefore very positive that many advisors appeared to have this knowledge prior to viewing the video. Fourteen additional individuals mentioned working with individuals with disabilities as a volunteer experience to include on an application and more importantly to prepare for a genetic counseling graduate program. Working with individuals with disabilities was directly mentioned in the video intervention as a beneficial experience to include on an application. Nine fewer individuals suggested hospital or clinic volunteering in the post-survey. Hospital/clinic volunteering was not mentioned in the video as one of the most common experiences seen on applications to genetic counseling. It is likely that participants mentioned this based on their experience with students applying to medical

school due to genetic counseling being an allied health profession. Both of these data points indicate that the participants did retain relevant information from the video and were able to document that retained knowledge in an open-ended format.

The last open-ended question asked participants to ‘give a brief description of the students with which you have discussed genetic counseling in the past and/or may discuss with in the future including major, year in education, interests, ethnicity etc.’ Of note, 9 individuals listed “white,” and 9 individuals listed “female” regarding the students that they have advised or plan to advise in the future on genetic counseling. This is particularly concerning as it appears to perpetuate the significant lack of diversity in the genetic counseling field. Ninety percent of current certified genetic counselors are white and 95% are female according to the most recent professional status survey reported by the National Society of Genetic Counselors (NSGC 2021). These advisors are reporting that their student demographic that may be interested in the field does not at all differ from the current demographics.

Advisors also reported on demographics of their students apart from gender identity and ethnic background. The 10 participants that mentioned “originally pre-med-track or career changers” and “health science/public health majors” indicate that many students who are interested in genetic counseling were previously interested in the health care field.

Future Directions

This study did not collect data on how the participant was invited to complete the survey, whether it was through the National Association of Advisors for the Health Professions (NAAHP) email listserv or direct email from the lead researcher. A future study may add this question into the survey design to assess the ideal recruitment strategy for this advisor population to attempt to gain a more representative sample size. Additionally, future studies may be able to target national organization email listservs for other advisor types such

as academic or general career. As previously discussed, it was apparent in this study that all three advisor types gained knowledge from the informational video intervention. Therefore, it is important that future studies continue to recruit a wide range of advisor types to ideally benefit the largest number of students.

The current study emphasized the benefit of use of a video intervention tool regarding genetic counseling for this population. Future studies should aim to investigate the best strategy to implement a widescale intervention effectively. Ideally, undergraduate advisors across the country can benefit from this format of information distribution and future studies have the opportunity to reach closer towards this goal.

Future studies may adjust some elements of the survey design, both the questions and the video intervention, to enhance the knowledge gained by advisors, and to increase the ability to detect improvement in knowledge for relevant topics that weren't evaluated in this study. Firstly, some of the knowledge questions were answered correctly by nearly all advisors in the pre-survey indicating a generalized knowledge of these topics prior to viewing the video intervention. Therefore, future studies could replace these with questions that are more targeted and specific. For example, one of the questions asked in this study that received 65 of 67 possible correct responses in the pre-survey was: True/False Genetic counselors can be of any gender identity. This question could be replaced by: True/False 8% of certified genetic counselors identify as male.

Secondly, the knowledge questions regarding the genetic counseling profession received a higher proportion of correct responses in the pre-survey than the questions regarding the genetic counseling graduate program requirements. Therefore, it appears that advisors have more knowledge regarding the genetic counseling profession. However, nine questions were asked regarding the profession and only three questions were asked regarding the genetic counseling graduate program requirements. Future studies could consider adding

more questions about the graduate program requirements as this is an integral aspect of the advising session. This study demonstrated that not only do advisors seem to lack knowledge in this area but also that a video intervention increases that knowledge.

Thirdly, the open-ended question regarding the advisors' student demographics was asked at the end of the survey. The completion rate for this question was over 60%. Even at the end of the survey, many participants were willing to take the extra time to enter a free text response. This indicates that there is room for additional open-ended questions in this survey. Future studies could take this opportunity to further assess student and advisor demographics and attempt to better understand the lack of diversity within the field from the perspective of student recruitment.

Lastly, based on the relatively high completion rate of the survey (over 65%) future studies may consider creating a longer and more detailed video intervention. The video in this study was just over 7 minutes in length and the estimated time to complete the survey in its entirety was 20 minutes. The fact that most individuals completed the entirety of the survey after watching the video intervention indicates that this population is significantly interested in learning about the topic and the majority of participants would still be likely to complete the entire survey even if the video was longer. In a broad sense, a future video could include a more in-depth discussion of the roles of a genetic counselor and the graduate program requirements rather than simply listing these points in the video. More specifically, additional points that could be addressed in a future video include a focus not limited to the genetic counseling profession. There are so many career options involving genetics that are rapidly evolving alongside genetic counseling. Future videos may discuss the difference between a medical geneticist and a genetic counselor and how the two roles do and do not interact in a clinical setting. Additionally, an emphasis could be made on the large number of career opportunities in the genetics field including becoming a geneticist, working in research etc.

Limitations of the Study

The limitations of this study include a relatively small sample size, a female dominated and potentially biased cohort of advisors.

Unfortunately, although attempts were made to reach potential respondents by distribution through the NAAHP and by direct email from the lead researcher, only 103 participants began the survey, and 67 participants were included in the full analysis. This is a small sample size when compared to the population of advisors in the country. The study had limited power to explore differences between potentially important subgroups such as advisor type and previous advising experience, because of the small sample size. While you did not find significant differences between most subgroups with respect to knowledge or the effect of the video, this does not mean that important differences do not exist. However, due to the nature of the survey being a pre- and post- design, there was still a significant amount of power in the analysis that was conducted and a lot of meaning from the results that were demonstrated in this paper, regardless of their statistical significance.

Nearly 80% of the study advisor population identified as female. According to a 2018 study at Colgate University, the undergraduate advisor population is approximately 47% female (Takao 2018). Therefore, this sample may not be representative of this country's undergraduate advisor population in terms of gender. This demographic difference may be due to the female dominated nature of the genetic counseling field, potentially attracting more females to open and complete the survey.

It is possible that the advisors surveyed in this study were biased to those that were particularly interested in the topic of genetic counseling or eager to learn about the field. This is substantiated by the high percentage of advisors surveyed that had heard of genetic counseling and even advised on genetic counseling previously (*Figure 1 and 2*). These individuals therefore may have been more likely to retain information from the video

intervention due to their pre-existing intrigue. If this is the case, the significant increase in knowledge from pre- to post-survey response may not be generalizable to all undergraduate advisors. However, even if only a portion of undergraduate advisors were to be reached by this form of information giving, this could make an impact on the increased recruitment of students to the field.

Conclusions

In conclusion, this was a unique study that revealed the benefit an informational video intervention can have on all advisor types from various universities across the country. From career to academic advisors in an undergraduate setting, this population is apparently underutilized as a vessel for student recruitment to the genetic counseling profession. There is an apparent lack of knowledge in specific aspects of the genetic counseling field that are integral to a successful advising session. When given information in the form of a video, advisors across the spectrum demonstrated increased knowledge on both the genetic counseling profession and the genetic counseling graduate program requirements. Additionally, this study revealed that there is ample opportunity for future studies as advisors appear to be a population that is ready and eager to learn more about genetic counseling as a potential career opportunity for their students. If advisors continue to gain knowledge on genetic counseling and subsequently confidence in their advising skills on the profession, it will allow for a much larger number of students to be introduced to the field and likely increase interest among those that otherwise would not have been aware of the opportunity.

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APPENDIX A

Dear Undergraduate Advisor,

My name is Madi McFarland, and I am a graduate student at the University of California, Irvine. I am recruiting participants to complete a survey aimed at assessing undergraduate advisors' comfort level advising on the field of genetic counseling.

You are eligible to participate in this study if you are at least 18 years of age or older and are a currently or formerly employed undergraduate advisor.

The study can take place in any setting available to you. Your participation will last up to 20 minutes. This will include a short informational video between two sets of survey questions.

In this email, there is a link that will take you to the anonymous survey. If you choose not to participate in this study, there is no need to open the link. If you are interested in participating in this study, please open the link to complete the survey.

If you have further questions, please contact Madi McFarland at mtmcfarl@hs.uci.edu or 714-456-5837.

Thank you so much!

You may open the survey in your web browser by clicking the link below:

[Please click this link for survey.](#)

If the link above does not work, try copying the link below into your web browser:

<https://ci-redcap.hs.uci.edu/surveys/?s=TEXMN4KL88>

This link is unique to you and should not be forwarded to others.

APPENDIX B

FULL REDCAP SURVEY INSTRUMENT BELOW:

Please answer the following questions. Thank you!

Gender Identity

- ☐ Female
- ☐ Male
- ☐ Transgender Female
- ☐ Transgender Male
- ☐ Gender non-conforming
- ☐ An identity not listed
- ☐ Prefer not to disclose

Age

- ☐ 18-35
- ☐ 36-50
- ☐ 51-65
- ☐ Over 65

Are you a currently employed advisor or have you previously been an academic advisor?

- ☐ Currently employed as an advisor.
- ☐ Previously employed as an advisor.
- ☐ Never been employed as an advisor.

Approximately how many undergraduate students are at the university you currently or previously worked for?

- ☐ Less than 3,000
- ☐ 3,000-10,000
- ☐ More than 10,000

Is the university you work for or previously worked for a liberal arts or technical university?

- ☐ Liberal Arts
- ☐ Technical

Is the university you worked for or previously worked for a private or public university?

- ☐ Private
- ☐ Public

Approximately how many students are you responsible for advising each year at your university?

- ☐ Less than 50
- ☐ 50-300
- ☐ 301-500
- ☐ More than 500

Which category best describes your position as an undergraduate advisor?

- ☐ Academic
- ☐ Health Career
- ☐ General Career

Within which department do you reside (e.g. Biology, Humanities, Informatics etc.)?

Which type of bachelor's degree do you hold?

- ☐ Bachelor of Science
- ☐ Bachelor of Arts
- ☐ Bachelor of Fine Arts

Is there a genetic counseling graduate school at your university?

- ☐ Yes
- ☐ No
- ☐ Unsure

Is there a genetic counseling special interest group (SIG) at your University?

- ☐ Yes
- ☐ No
- ☐ Unsure

Have you been or plan to be involved in a career fair at your University?

- ☐ Yes
- ☐ No

Please answer the following questions about your previous knowledge of genetic counseling

Have you heard of genetic counseling prior to this study?

- ☐ Yes
☐ No

Where did you first hear about genetic counseling?

- ☐ A student brought it up to me
☐ Through an academic article
☐ Through a media source
☐ Through a work experience
☐ Through a personal experience
☐ Other

Please specify "other":

Have you ever discussed genetic counseling with your students?

- ☐ Yes
☐ No

With how many students have you discussed genetic counseling?

- ☐ 0-1
☐ 2-3
☐ 4-5
☐ 6-9
☐ 10 or more

What resources have you provided to a student interested in pursuing a career in genetic counseling?

- ☐ National Society of Genetic Counselor's website
☐ Accreditation Council for Genetic Counseling's website
☐ Genetic counseling graduate program website
☐ Other website
☐ Pamphlet or other paper resource
☐ Referral to a local genetic counselor
☐ Other resource

Please specify "other":

Where did you obtain these resources about genetic counseling? (Choose all that apply).

- ☐ During a training session
☐ At a seminar
☐ Online
☐ From a previous student
☐ Other

Please specify "other":

Did you bring up genetic counseling to these students unprompted or did they inquire about the career and application process?

- ☐ I brought up genetic counseling
☐ The student inquired about genetic counseling

Which of the following best fit why genetic counseling has not yet come up in any of your advising sessions?

- ☐ I have heard about the profession but did not feel confident discussing with a student.
☐ I have heard about the profession but have not had the right student to present it to thus far.
☐ I have heard about the profession but have not had any students inquire about the profession thus far.
☐ I did not previously know about the profession at all

If a student came to your office to discuss genetic counseling, how confident are you in discussing the genetic counseling profession with students?

- ☐ Very confident
- ☐ Somewhat confident
- ☐ Somewhat unconfident
- ☐ Not at all confident

The following set of questions will ask about the genetic counseling profession. We do not expect that participants will know all the answers to these questions. Please answer

Genetic counselors work with preconception and prenatal (those that are planning to become pregnant or are currently pregnant) patients only.

- ☐ True
☐ False
☐ Unsure

A genetic counselor must complete a medical degree (e.g. MD or DO) to practice genetic counseling.

- ☐ True
☐ False
☐ Unsure

If an individual currently receives counseling from a licensed therapist, it will never be necessary for that individual to see a genetic counselor.

- ☐ True
☐ False
☐ Unsure

Genetic counselors assist couples to select for specific aesthetic traits such as eye color or height to create the most desirable offspring.

- ☐ True
☐ False
☐ Unsure

How many years does it typically take to complete a genetic counseling graduate program?

- ☐ 1
☐ 2
☐ 5

All genetic counselors must support pregnancy termination.

- ☐ True
☐ False
☐ Unsure

Every genetic counselor must have another medical professional present in all sessions they conduct with a patient.

- ☐ True
☐ False
☐ Unsure

Genetic counselors may be of any gender identity.

- ☐ True
☐ False
☐ Unsure

Some genetic counselors do not work directly with patients, but rather work in a laboratory setting.

- ☐ True
☐ False
☐ Unsure

If a student came to your office to discuss genetic counseling, how confident would you be in discussing the application process to genetic counseling graduate programs?

- ☐ Very confident
☐ Somewhat confident
☐ Somewhat unconfident
☐ Not at all confident

The following set of questions will ask about the application process for graduate programs in genetic counseling. We do not expect that participants will know all the answers to these questions. Please answer to the best of your ability and do not ask others for help or search

How many accredited graduate programs in genetic counseling are there in the United States and Canada?

- ☐ About 15
- ☐ About 50
- ☐ About 100
- ☐ Unsure

A prospective genetic counseling graduate student must have a bachelor's degree in science.

- ☐ True
- ☐ False
- ☐ Unsure

All genetic counseling graduate programs require prospective students to have experience shadowing at least one genetic counselor before applying.

- ☐ True
- ☐ False
- ☐ Unsure

What would you suggest to a student as relevant volunteer experience for a graduate program in genetic counseling application?

You will now be asked to watch an informational video before continuing with the

Would you prefer to watch the video with or without
the view of the presenter?

- ☐ With view of the presenter
☐ Without view of the presenter

Please watch the following video before proceeding with the survey. Thank you!

Please watch the following video before proceeding with the survey. Thank you!

Please answer the following questions about how you may utilize the information and resources found in the video in the future.

Would you use the information and resources provided in the video with students directly in the future?

- ☐ Yes
☐ Maybe
☐ Definitely not

Following the video, are you more likely to discuss this career with a larger number of students?

- ☐ Yes
☐ Maybe, but I am still not confident
☐ No

What resources would you be inclined to use with students following the video?

- ☐ National Society of Genetic Counselor's website
☐ Accreditation Council for Genetic Counseling's website
☐ Genetic counseling graduate program website
☐ Other website
☐ Pamphlet or other paper resource
☐ Referral to a local genetic counselor
☐ Other resource

Please specify "other":

The following set of questions will ask again about the genetic counseling profession. Again, we do not expect that participants will know all the answers to these questions.

Genetic counselors work with preconception and prenatal (those that are planning to become pregnant or are currently pregnant) patients only.

- ☐ True
☐ False
☐ Unsure

A genetic counselor must complete a medical degree (e.g. MD or DO) to practice genetic counseling.

- ☐ True
☐ False
☐ Unsure

If an individual currently receives counseling from a licensed therapist, it will never be necessary for that individual to see a genetic counselor.

- ☐ True
☐ False
☐ Unsure

Genetic counselors assist couples to select for specific aesthetic traits such as eye color or height to create the most desirable offspring.

- ☐ True
☐ False
☐ Unsure

How many years does it typically take to complete a genetic counseling graduate program?

- ☐ 1
☐ 2
☐ 5

All genetic counselors must support pregnancy termination.

- ☐ True
☐ False
☐ Unsure

Every genetic counselor must have another medical professional present in all sessions they conduct with a patient.

- ☐ True
☐ False
☐ Unsure

Genetic counselors may be of any gender identity.

- ☐ True
☐ False
☐ Unsure

Some genetic counselors do not work directly with patients, but rather work in a laboratory setting.

- ☐ True
☐ False
☐ Unsure

APPENDIX C

List of resources provided to the advisors upon completion of the survey:

- NSGC recruitment video: <http://www.aboutgeneticcounselors.com/About-Genetic-Counselors/Considering-Genetic-Counseling-as-a-Career>
- ACGC list of schools: <https://www.gceducation.org/program-directory/>
- NSGC Video on what is a Genetic Counselor:
<http://www.aboutgeneticcounselors.com/who-are-genetic-counselors>
- Association of GC Program Directors Brochure:
<https://www.med.wisc.edu/media/medwiscedu/documents/education/genetic-counseling-program/agcpd-genetic-counselors-brochure.pdf>
- “Find a Counselor” on NSGC website: <https://www.nsgc.org/page/find-a-genetic-counselor>
- US Bureau of Labor Statistics: <https://www.bls.gov/ooh/healthcare/genetic-counselors.htm>
- Dena DNA (Social media platforms focused on the genetic counseling profession: Facebook, Instagram, twitter and TikTok)

Link to survey informational video that was embedded in the survey:

<https://uci.yuja.com/V/Video?v=2164466&node=8036001&a=1032694085&autoplay=1>

APPENDIX D

All responses from open ended question:

Pre-survey responses

I would encourage them to shadow but then suggest general clinical volunteering to get to know the larger system and healthcare team.
Shadowing one of the genetic counselors at our university
Almost anything involving humans - Crisis text line, Boys and Girls Club, hospital volunteer work
Crisis hotline
Start by shadowing a genetic counselor, but probably any interaction with a "patient" (loosely defined) in a health care setting is a good place to start.
Shadow/informational interviewing of a genetic counselor, volunteering/shadowing fertility/OBGYN, clinical experience in fields with genetic disorders. Depends on applicants' interests.
Look at the requirements of the program to which you want to apply. See what they "count" as "relevant volunteer experience."
Shadowing a genetic counselor, and as for volunteerism, anything that would hone competencies such as effective communication, building trust, empathy, explaining complex ideas, compassion, resilience...
I would recommend that they find a genetic counselor and conduct an informational interview with them. I would also recommend that they participate in research.
March of Dimes
Suicide crisis hotline; peer counseling
Mentoring, crisis counseling, working one on one with a patient or client of some sort
Crisis hotline, Something with crisis management and emotionally supporting others in some way

Conduct some research in a specific genetic conditions and volunteer at one of the various centers associated with that particular disorder.
I would suggest volunteering in hospitals and other clinical settings, as well as conducting shadowing and potentially research alongside a faculty member studying the material.
I would not know what to suggest, other than looking for opportunities at hospitals.
Experience in any setting that involves working directly with someone who has a demonstrated need the student is there to help meet through conversation. This could be in a clinical or non-clinical setting.
I would refer a student to our pre-health advisor and/or help the student review application information online for their desired grad program (so that we could see what that particular program recommended and/or the student could be in touch with someone
Experience in working with individuals - perhaps as a crisis line volunteer.
Job shadow, laboratory experience, clinical experience, volunteer at hotline
Counseling experience (e.g. in a crisis hotline, a domestic violence shelter or hotline, or a text hotline), teaching or tutoring experience, research experience, experience in medical settings like hospitals and community clinics, and volunteer (or wor
Counseling type volunteer service
Any volunteer experience in the community to gain people skills so that they know they are a good fit for interacting with people.
I really don't know but suspect that students could volunteer in health clinic setting or something similar.
OB GYN shadowing nurse midwife shadowing
intern, shadow or volunteer with a practicing professional

Any opportunity that calls upon empathy and then advocacy
Something related to patient care or patient education
Informational interview w/ a genetic counselor; shadowing if the GC is open to it; research
Volunteer with a Crisis Center to gain experience helping people who are in distress or in a painful, confusing situation, to learn how to communicate well, and help clients understand their situation and empower them to make choices right for them.
I typically suggest that they volunteer for crisis hotlines or as a paraprofessional through our counseling center or health center.
Advocacy or crisis work, for example volunteering with a crisis hotline
Reproductive health clinic.
Any volunteer experience should suffice
Rape Crisis Hotline Volunteer at Planned Parenthood Volunteer at a GC clinic
Clinical volunteering like hospice or memory care or counseling roles like crisis hotline or mental health peer support groups
I would advise to do something counseling related, like volunteering with a crisis text line, at a center for youth experiencing mental or behavioral health issues, or a center that works with those who have experienced rape or domestic violence.
anything that allows students to improve their connection/communication skills and demonstrate their genuine desire to serve others. I would particularly encourage students to reach out of their comfort zone to work with marginalized and vulnerable popul
hospice volunteering, crisis hotline or text line, women's center, or other counseling-related experience. Additional experience working with others in emotionally challenging circumstances could be valuable.

Crisis hotlines, COVID contact tracing.
prefer experience with genetic counseling but crisis line work , perhaps working with special needs populations, an experience that develops strong communication skills, some psych experience along with biological sciences. If they were more interested in
Not sure what would be relevant. Any type of crisis hotline seems like it would be a good experience for the student to learn how to handle difficult situations.
Contact local hospitals and health clinics about volunteer and shadowing opportunities (broadly-not genetic counseling specific)
Inquire about research opportunities with instructors in the field (there are some in my university). Cold calling hospitals in the area or back home for opportunities, starting a position in healthcare and building networks. All volunteer experience is good
Ideally shadowing a genetic counselor, otherwise other health care related opportunities, particularly in NICU, OB-GYN, family medicine, or specialties related to genetics/genetic diseases.
possibility of shadowing a genetic counselor at the hospital.

Post-survey Responses

Shadowing a genetic counselor or at least interviewing them. Volunteering with a counseling setting like a crisis line or with people with disabilities and any other healthcare volunteering.
Interview someone in genetic counseling
Anything with humans
Same as before. Shadowing/informational interviewing of genetic counselor and clinical experiences in related fields depending on the applicants' interests. Pediatrics,

genetic diseases/disorders/conditions that are genetic/fertility, etc.
shadowing or informational interviewing with a genetic counselor, and any volunteerism that promotes personal growth in communication skills, empathy, trust building, explaining complex ideas, curiosity, resilience...
Crisis helplines; working with students or adults with developmental disabilities
Working in an ob/gyn office, or with people with disabilities
I would recommend working in a lab through research on campus. I would also recommend volunteering in the community as a crisis counselor or working with people who have disabilities.
suicide prevention hotline; working with people with disabilities; laboratory experience
crisis hotline working with populations with disabilities emotional support roles
Lab, research or patient focused volunteer hours plus shadowing if possible.
Counseling-related volunteer work like a crisis hotline, working with people with disabilities and other hospital volunteer work, research and shadowing
Crisis line or shadowing
Already answered this.
Shadowing a genetic counselor, volunteering for crisis/mental health
Contact and interact with a licensed genetic counselor.
any
I would suggest they volunteer in a counseling setting or health clinic.
disabilities services crisis hotlines genetic counseling interviews
Refer to young alum practicing as licensed genetic professional.
Crisis hotline, work with people with disabilities.

Crisis hotline
working with people with disabilities, Crisis Center volunteer
working for any crisis help line
Advocacy or crisis work, experiences working with individuals with disabilities
Disability settings Early Childhood education Reproductive health Mental health settings Laboratory/research projects
Same as prior answer + work with developmentally disabled individuals
Counseling related volunteering such as crisis text line and working with people with disabilities.
any opportunity that demonstrates an applicant's interest in being of genuine service to others and one that helps them develop connection and communication skills. and ideally opportunities that put them in contact with people with different lived experi
hospice volunteering, crisis hotline or textline, women's center, or other counseling-related experience. I don't consider it to be volunteer experience so I didn't mention it earlier, but shadowing a genetic counselor and research experience could also
Crisis counseling, COVID contact tracing, working with people with disabilities.
same as before
Crisis hotlines
It is difficult to shadow a genetic counselor, so students broadly interested in health fields who do not want to be a doctor or nurse are a good fit. Similar volunteering experience should suffice.

All responses from open ended question: Lastly, please give a brief description of the students with which you have discussed genetic counseling in the past and/or may discuss with in the future including major, year in education, interests, ethnicity etc.?

- “I have only had 2. The first was a review of their personal statement. I helped them revise the statement but they explained the school match system to me. They were a white female senior. The second is a white female as well and is a freshman.”
- “Students in health science and/or public health in my Foundations of Health Education & Promotion class”
- “All of the students with which I have discussed genetic counseling programs have been white, female students of middle-income backgrounds who were "in-state" students at our public research university. They had been pre-med at one point but decided that t”
- “From time to time they come in. Range of years/majors. Many have family members with genetic disorders/conditions and become interested.”
- “freshmen through alumni, who either discovered the career on their own or want a career in health profession, interacting with people, using science to solve problems but not treating people.”
- “For me, this would be students who are getting their degree in Speech, Language, and Hearing Sciences but no longer wish to become an SLP or Audiologist. This could be another health related field that I could introduce for them to explore.”
- “Mostly work with our MS students in their career and job search plans, resume writing, interviewing skills. Work with undergraduate arts & science students considering graduate school.”

- “I have not had an opportunity to speak with students about genetic counseling as a career option.”
- “A student asked if pursuing an graduate program in genetic counseling would make her more competitive for med school down the road. I wasn't sure (and I'm still not sure) if it would, but I advised there are specific programs in place to get her into med”
- “This field can be a good fit for any student who is looking for a career that supports people in challenging times, that can educate on complex topics, or who wants to use their science expertise in a different setting than a hands-on healthcare field.”
- “mostly white women 1st year students who had heard about it through family members prior to college”
- “The majority have been either Biology or Neuroscience majors who have either heard about genetic counselors before or were already interested in genetics research. They have been predominately white females.”
- “Students will likely be from a science background and will be either a junior or senior.”
- “Pre-health students, all majors, all years at the university”
- “It was a science major, originally premed but after hearing about the field and attending part of a conference changed their mind their junior year”
- “I haven't done any in the past, but understanding it a bit better, I can see myself visiting with any student who is interested in the medical profession but isn't sure what they want to do within the field.”
- “Biology majors, sophomore/juniors, varied ethnicities”
- “Biology student whose brother carries dangerous marker.”

- “I have worked with about 10 students-100%women-in the past year who have decided to pursue careers in genetic counseling. All science majors. All planning about 2 years between college and grad school.”
- “Typically Biology, Biochemistry or Psychology majors in the sophomore or junior year. Female and white because that is what the majority of my students are. They are usually interested in a health care related field but don't want to go to medical school.”
- “primarily undergraduates of any major, though usually they are in the sciences or social sciences at our institution”
- “Biology majors, freshmen - seniors. Have a keen interest in molecular genetics. Looking for ways to help others outside of traditional medicine.”
- “Any student who expresses an interest”
- “Prehealth interest (typically life science majors). Mostly white (pretty much all that comes through our door in Wyoming). Varied year in school.”
- “Career Changers”
- “The tend to be female, students of color in second or third year of undergraduate program with strong interests in biology along with anthropology/sociology”
- “I work primarily with Biology majors. Students are typically very interested in science, especially genetics. They will sometimes want to have a concentration in genetics for their Biology degrees. They want to work with people, but not interested in being a doctor”
- “a variety of students -- majors in biology, biological sciences, molecular genetics, psychology, health sciences== at various stages of their undergraduate careers.”
- “We advise close to 3,000 pre-health students. I apologize, but I don't remember specific demographic information about each one who has been interested in genetic counseling.”

- “Pre-genetic counseling is a formal track at our institutions. I've discussed GC with students who bring the interest to me, suggested it to students who are considering their options, and suggested it to students who are dissatisfied with the clinical health field”
- “too many to list I also briefly bring it up in my Human genetics class and have them review the website”
- “Those interested in genetics and health fields but unsure of what direction they want to go with their undergraduate degree.”
- “The only two students I have discussed it with were white females who had previously considered pre-med. It is something I may suggest more broadly to students interested in helping professions related to medicine but who are not going the traditional pre-med route”
- “Sophomores for the most part. Young Caucasian women. Either Health Science or Public Health students.”
- “I work with biology students, many of whom are pre-health. I've brought up genetic counseling if a student expresses an interest in genetics and helping people. It's listed on a handout that includes pre-reqs/average scores for entry with a wide range of majors”
- “None”
- “I have not ever discussed genetic counseling with any students. I honestly have never heard of genetic counseling until this survey. I previously advised a variety of students including Pre Health at a previous institution and this information was very informative”
- “I previously worked at an institution that did have a graduate program in genetic counseling and so it was more common for students to know about this opportunity and ask me about it during advising sessions. I found it to be an attractive option for students”

- I work with pre-health students and many of them don't know about genetic counseling but might be a good fit for this profession rather than a better known profession. The students I work with can have any major and are undergraduate students.”
- “Most psychology majors at our university want to avoid biology. They complain about the current BIO requirements of the degree. When a psychology student comes to me seeking advice and they did well in their biology courses and/or have taken chem or other”
- “It is difficult to shadow a genetic counselor, so students broadly interested in health fields who do not want to be a doctor or nurse are a good fit. Similar volunteering experience should suffice.”
- “any opportunity that demonstrates an applicant's interest in being of genuine service to others and one that helps them develop connection and communication skills. and ideally opportunities that put them in contact with people with different lived experience”
- “shadowing or informational interviewing with a genetic counselor, and any volunteerism that promotes personal growth in communication skills, empathy, trust building, explaining complex ideas, curiosity, resilience...”

APPENDIX E

Email responses from two participants:

“Thanks for doing this and inviting pre-health advisors like me. This was super helpful for me!” – Health career advisor

“Thank you for some very interesting information! Your survey was excellent and I especially enjoyed your video. I hope your survey gets a great response rate and you get some valuable information.” – Academic Advisor

See Table on following page:

APPENDIX F

Table 6 Pre- and Post-Survey Scores for All Knowledge Questions for Each Participant

Participant	Pre-survey score	Post-survey score	Difference
1	7	10	3
2	11	11	0
3	11	11	0
4	2	6	4
5	4	11	7
6	8	7	-1
7	8	8	0
8	8	12	4
9	8	10	2
10	5	6	1
11	9	11	2
12	7	11	4
13	8	10	2
14	7	9	2
15	6	10	4
16	8	12	4
17	9	9	0
18	4	7	3
19	3	7	4
20	1	8	7
21	4	3	-1
22	7	11	4
23	7	9	2
24	8	11	3
25	10	10	0
26	9	8	-1
27	9	10	1
28	12	10	-2
29	7	12	5
30	4	7	3
31	8	12	4
32	4	-5	-9
33	8	12	4
34	10	11	1
35	3	10	7
36	7	10	3
37	7	10	3
38	10	12	2
39	-2	-4	-2
40	11	12	1
41	1	-3	-4
42	5	10	5
43	6	9	3
44	8	12	4
45	7	12	5
46	10	10	0
47	9	12	3
48	5	7	2
49	10	12	2
50	8	10	2
51	8	10	2
52	6	11	5
53	10	12	2
54	9	9	0
55	10	12	2
56	8	11	3
57	9	12	3
58	8	10	2
59	8	11	3
60	5	12	7
61	5	10	5
62	4	2	-2
63	5	12	7
64	1	8	7
65	11	11	0
66	0	7	7
67	1	12	11