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Knowledge of Family Health History and its Association with Social Determinants of Health and Personal Medical History

THESIS

Submitted in partial satisfaction of the requirements
for the degree of

MASTER OF SCIENCE
in Genetic Counseling

by

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DEDICATION

To

Mom and Dad; you've always shown me that I'm capable of anything, thank you for believing in me when I didn't believe in myself. I wouldn't be here without you. Thanks for helping me to not look back and leave it all on the track. I love you!

Riley; let's keep on chasing our childhood dreams together, you're up next! I love you!

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ABSTRACT OF THE THESIS

Knowledge of Family Health History and its Association with Social Determinants of Health and Personal Medical History

by

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Knowledge of family health history (FHH) is a key component of genetic counseling practice. As practitioners, it is important to be aware of the factors that can affect a patient's knowledge of their FHH, which can impact the ability to provide accurate risk assessment. In addition, guidelines to determine who is eligible for genetic testing and recommendations for management often incorporate FHH information and applying these guidelines without understanding that some individuals may have limited FHH knowledge leading to inequities in care. This research project was designed to explore these factors by analyzing the relationships between reported knowledge of FHH, reported presence of anxiety and depression within a family, and social determinants of health (SDoH) related to support, relationships, perceived stress, and religion and spirituality. Using the All of Us Research Researcher's Workbench, data was collected from the SDoH, FHH, and Demographics surveys, with sample sizes of 117,023, 184,155, and 410,361 respectively. Analysis revealed significant differences in reported

knowledge of FHH in various racial/ethnic backgrounds ($p<0.00001$) and gender identity ($p<0.00001$). In three SDoH categories analyzed (support, relationships, and perceived stress) higher average SDoH scores were seen for those who reported higher FHH knowledge ($p<0.01$). In addition, within all SDoH categories examined participants who reported personal anxiety or depression have lower average SDoH scores compared to those who reported no personal anxiety or depression ($p<0.05$). Participants who reported a personal history of HTN also had lower SDoH scores in the category of support compared to those who had no personal history ($p<0.05$), but interestingly had higher SDoH scores for perceived stress (reflecting less reported stress) and for religion and spirituality ($p<0.05$). The results of this study are valuable in gaining perspective about factors that may be associated with a patient's knowledge of their FHH. Understanding that patients come to healthcare providers with various levels of FHH knowledge and how certain SDoH factors are associated with FHH knowledge has the potential to improve the ability to provide personalized care for all patients. In addition, it provides information about the importance of taking into account a patient's FHH knowledge when determining a differential diagnosis, the type of carrier screening to order, or a patient's eligibility for genetic testing.

1. INTRODUCTION

1.1 Culture, Race, and Ethnicity

Where does one's identity come from? There are arguments that it is a personal decision, made without any outside input. while others argue that an identity is shaped by those around you, that their beliefs and experiences can end up shaping your own. One method of shaping an individual's identity is through their culture, which is defined as a "internalized and shared schema or framework that is used by group (or subgroup) members as a refracted lens to "see" reality, and in which both the individual and the collective experience the world" (Kagawa Singer et al., 2016). Whether it is a dish shared at a family gathering, a shared practiced religion or prayer, a method of celebration or mourning, a way of communication or a particular outlook on life, we are surrounded by culture, whether we are aware of it or not. In the Oxford Handbook of Identity Development, Frank Worrell makes a convincing argument that in fact your identity development can be linked to the culture that surrounds your race and/or ethnicity association (Worrell et al., 2016). He discusses that the development of identity comprises two main questions; 'who am I?' and 'what group do I belong to?', also known as personal identity and social identity. Those that surround you influence your identity, but it is your own decision about whether to accept their version of the identity or to choose and/or adapt your own. Worrell's primary argument concludes with discussing how culture, racial identity, and ethnic identity all reside within the same family; and are interchangeable with one another. Simply put, one's racial and ethnic identification are not solely biological or genetic, but also psychologically determined.

Communication is a vital component of one's race and ethnicity identification and is a method to hold and share important cultural information. In a study done by Virginia Dumitrescu, it is discussed that language is the primary medium in which communication occurs, communication of important culture components such as values, patterns of thought, and preferences (Dumitrescu et al., 2013). Just as language differs, the culture that aligns differs and creates a world comprised of people groups with various customs, values, and thought patterns.

A particularly important area of current research is examining how the communication of family health history (FHH) differs within various cultures. Family health history is an important piece of medical care, particularly used as a screening and/or diagnostic tool that can reveal possible risks or familial/genetic conditions. A study by Soo Jung Hong explores this communication style specifically in European American, Chinese American, and Korean American cultures. Specifically, it aims to explore the impact that familial boundaries, subjective norms, stigma, and privacy can impact the ability of the family to share their health history or a current diagnosis. The results of Hong's research found that perceived closeness to family members, whether that be parents, aunts/uncles, or grandparents, is positively correlated with a higher comfort in sharing FHH. In addition, it was discovered that the stigma surrounding the condition or diagnosis was an important factor that determined whether individuals shared their FHH. When comparing across gender, it was found that females, compared to males, had a wider perceived family and privacy boundary, and therefore felt more comfortable sharing FHH with a larger number of family members. When comparing cross-cultural answers, it was found that those who identified with Chinese American and Korean American cultures perceived family and privacy boundaries were narrower (when compared to those who identified with the European American culture), showing comfort sharing FHH with less of their family (Hong et

al., 2017). Limited research has been done within this area and further research is warranted to determine if there are differences in communication of FHH between other racial and ethnic groups.

This study aims to assist in further research, looking into racial and ethnic groups to compare knowledge of FHH and if there are differences in sharing various types of medical information. To give an overview of the diversity within the US, the most recent census data from July 1st, 2022, shows that there are approximately 333,286,557 people residing in the United States. Of those hundreds of millions of individuals, the race and ethnicity breakdown of the United States is shown below (U.S. Census Bureau, 2022).

Table 1. Race and Ethnicity from US 2022 Census Data

Asian	6.3%
Black	13.6%
Non-Hispanic White	58.9%
Hispanic/Latino(a)	19.1%
Another Population or More than One Population (Non-Hispanic/Latino(a))	4.6%

There will always be overlap between these five categories, and these five categories do not encompass all the racial and ethnic diversity that exist. Categorization of race and ethnicity in this paper was determined by following guideline recommendations established by the NIH (Lewis et al., 2023) and names of each category followed the naming established by the All of Us research program.

Individuals who marked Asian, Black, White, or Another Population or More than One Population are all individuals who do not identify as Hispanic or Latino(a). The individuals who marked Hispanic/Latino(a) are placed into the category regardless of if they identified with another group. The grouping decided above is based on recommendations of the NIH, as defined by their racial and ethnic categories listed as: American Indian or Alaska Native, Asian, Black or

African American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, and White (Lewis et al., 2023). Individuals who identify as Non-Hispanic/Latino(a) and American Indian, Alaska Native, Native Hawaiian, or Pacific Islander are within the Another Population or More than One Population category.

1.2 Social Determinants of Health

Social determinants of health (SDoH) are non-medical factors, such as the conditions of everyday life, which influence one's health outcomes. Some examples of SDoH include; income, education, employment status/job security, food insecurity, housing/neighborhood, social life/community, and religion/spirituality (*Social Determinants of Health*). These circumstances are important to acknowledge and be aware of in patients because they have been shown to have power to shape our health. Multiple studies have found that one's SDoH can account for a 30% to 55% impact on one's medical outcome (*Social Determinants of Health*), while others have reported numbers from 40% to 80% (Hood et al., 2016). Studies have shown that life expectancy increases in proportion to one's level of education, and infant mortality decreases proportional to the mother having a higher level of education. Children and adolescents with bad health and chronic disease were more commonly found to be in lower income households (Braveman et al., 2014). When looking at SDoH from a global perspective, there was found to be a difference of an 18-year life expectancy when comparing high-income to low-income countries (*Social Determinants of Health*). Conclusively, social determinants of health have been shown to be an extremely powerful determinant of impacting one's health.

There has been extensive research within the last two decades focusing on how these SDoHs, particularly socioeconomic status and education, can impact one's health, but there

remains a gap in research focusing on psychology related SDoHs and their impact on health outcome. In a recent literature review done by Julianne Holt-Lunstad, the current research on connectedness as a determinant of health is reviewed (Holt-Lunstad et al, 2022). The author proposes a framework for social connectedness, that connectedness can be measured in three ways: structural, functional, and quality. Structural incorporates social relationships, including marital status, social networks/integration/isolation, and living alone. Functional encompasses what is received from the presence of those social relationships, examples include receiving support, perceptions of social support, and perceived loneliness. The last category, quality, looks at the positive or negative qualities of the social relationships including; marital quality, social strain, and social inclusion/exclusion. Simplified, the research is focusing on whether the social connection is present, whether the social connection is positive or negative, and what the impact of that is on one's health.

This study is focuses on support, relationships, perceived stress, and religion/spirituality. Although more research is warranted in these areas to determine how these SDoH related to knowledge of FHH, there is current research available showing their relatedness to health outcomes.

Recent studies have shown that social connectedness and relationships are important in multiple areas of one's life and throughout their life. A study done by Steiner et al. found that when individuals were found to have familial and friend connectedness (relationships), there was a lower chance of long-term worse outcomes related to mental health, violence, sexual behavior, and substance use. The study suggested that this significant finding was due to the relationships reducing emotional distress (Steiner et al., 2019). Another study by Stafford et al. showed that those with higher social connectedness reported more use of preventative treatments such as

blood pressure and cholesterol treatments, eyesight and dental visits, influenza screenings, and cancer screenings (Stafford et al., 2018). In another study conducted by Weziak-Bialowolaska et al, higher reported social connectedness was associated with lower risks of future diagnoses of anxiety and depression. Suggesting that ideation or perceived loneliness in an individual is a possible risk factor for an anxiety and/or depression diagnosis (Weziak-Bialowolaska et al., 2022). Lastly, a recent study done by Yang et al. showed that low social support, defined as the quality of one's relationships, was significantly associated with an increase of systolic blood pressure, which over time can lead to an increased risk for strokes, heart, and kidney disease. It was also found that low social integration, defined as the number and nature of one's social relationships, was predictive of an increased risk for developing hypertension. The study's findings let the authors suggest that the nature of one's relationships can lead to a stress response which could have implications for one's health (Yang et al., 2013).

When it comes to examining the associations between stress and particular health outcomes or diagnoses, a variety of research has been done which supports higher levels of stress leading to a more negative health outcome. A study conducted by Malik et al. has shown patients with a peripheral artery disease diagnosis have a poorer recovery when experiencing higher levels of chronic stress after their diagnosis (Malik et al., 2021). The amount of stress an individual experiences is often measured in research by their cortisol response. Specifically, levels of cortisol can be measured from morning to evening, also known as diurnal cortisol slopes. Research has shown that flatter diurnal cortisol slopes, i.e. no cortisol level change throughout the day, is indicative of more chronic stress and has been associated with poorer health outcomes. A study conducted by Adam et al examined the diurnal cortisol slopes and found a correlation with flatter slopes and poorer mental and physical health outcomes when it

came to cancers, depression, externalizing (defined as behaviors involving anger, aggressions, and delinquency), fatigue symptoms, inflammation/immune conditions, internalizing (categorized as symptoms that have a combination of anxiety and depression symptoms), obesity, mortality, other mental and physical health conditions (Adam et al., 2017).

Lastly, there have been a number of studies that look at the associations between religion/spirituality and health outcomes. A study recently conducted by Shattuck et al showed a significant but small correlation between an individual engaging in religion/spirituality behaviors and their benefit on health. The research showed that both the intrinsic belief system and the extrinsic support that religion/spirituality provider for the participants were both beneficial for a more positive health outcome (Shattuck et al., 2018). In another study conducted by Jim et al, they analyzed a sample group to determine the association between participation level in religion/spirituality practices and physical health. Physical health was defined as physical well-being (ability to complete everyday tasks that range from selfcare to physical tasks), functional well-being (a participant's perceived difficulty in completing task at home, work, or socially), and physical symptoms (self-reported fatigue, pain, sleep problems, cognition, etc.). The research concluded that there was a significant association between taking part in religion/spirituality practices and every aspect of physical health of the individual (Jim et al., 2015).

It is important to acknowledge within this research that lower SDoH are not causing individuals to have poorer health outcomes. Instead, SDoH are seen as a measurable predictor that can be used to determine a patient's possible health outcome. The findings above, and countless more, have shown that low social connectedness, less religion/spirituality experiences, and high stress can lead to poorer health, but it is possible that someone in poor health would

have a more difficult time engaging socially, building connections, have more stress, and less motivation to experience religion/spirituality. The research that exists is an imperative start to digging deeper into the psychology related SDoH to obtain a more well-rounded and thorough picture of how these factors can predict health.

1.3 Family Health History

It is common knowledge within the health care community that conditions such as heart disease, diabetes, cancer, as well as more rare conditions such as cystic fibrosis or hemophilia can run in families (*Understanding Genetics*, 2010). An individual's family health history (FHH) can be a vital and informative screening tool for health care professionals to collect to understand their patient's risk to develop certain conditions. There is a multitude of research that exists which shows pedigrees are underutilized by health care professionals other than those in a genetics specialty (Bendure et al., 2006). It is not only important for genetic professionals to use family history tools in practice but can also be of use in other healthcare settings to inform a provider of a patient's risk for multifactorial conditions such as diabetes or heart disease.

Collecting a pedigree is particularly vital in the genetic counseling profession. At the beginning of every first appointment with a patient, the intake visit, one of the first tasks completed by genetic counselors is to collect a three-generation pedigree (Wattendorf et al., 2005). The importance of three generations is to obtain a well-rounded picture of the entire family and presence or lack thereof of the suspected condition. 50% of one's genetic information is shared with their first-degree relatives (FDR) which include children, parents, and siblings. 25% of the genetic information is shared with second-degree relatives, which include

aunts/uncles, grandparents, half siblings, nieces/nephews. Lastly, 12.5% is shared with your third-degree relatives (TDR), which includes cousins and great-grandparents.

An important note to make is the difference between a pedigree and a genogram (Butler et al., 2008). A pedigree is more commonly collected in a genetics appointment or possibly by a primary care provider (PCP) and contains three generations of family members and their relative health conditions. On the other hand, a genogram, collected by mental health specialists, shows a person's family members, their health conditions, and relationships and inter-personal dynamics within the family.

How knowledgeable you are about your FHH can impact your health (Feero et al., 2008), yet there can be multiple roadblocks that prevent individuals from knowing the details of their FHH. A study conducted by Li et al. surveyed over 2,000 college students to obtain a framework of understanding how much FHH was known. It was found that general knowledge of FHH was low, with only 49% of participants reporting actively seeking out their FHH information from their family. Participants that identified as being a part of a racial/ethnic minority groups showed higher levels of anxiety and intention to obtain FHH but also showed lower confidence in their abilities to gather that information in comparison to Non-Hispanic White participants (Li et al., 2022). Another study, conducted by Binda et al, examined the comfort and limitations of sharing FHH intergenerationally. The research found that families were sharing general information with one another, but obstacles appeared when sharing medical information with their family. Participants explained that they were open to sharing but felt closed off when it resulted with getting questioned by family members or nagging about a developing a 'healthier lifestyle' occurred. In addition, there were also individuals that used a 'facilitator', instead of personally disclosing their medical details, they had a parent, or a sibling disclose it to the family instead.

One of the primary conclusions of the study was that families seen with supportive and connected relationships were more likely to feel comfortable with passing down or talking about their health information (Binda et al., 2018).

A study conducted by Palacios et al looked at the ethnic differences in reported cancer within a family. The study analyzed 795 pedigrees, focusing on the number of FDR and SDR who had reported cancers within four ethnic groups; non-Hispanic White, Hispanic/Latino(a), Asian, and African American/Black. The findings showed that reported cancer was lower in the Hispanic/Latino(a), Asian, and African American/Black groups compared to the non-Hispanic White group. Reporting was low in the non-White racial/ethnic groups when compared to the expected population incidence. The study concluded this was most likely due to a familial lack of knowledge about the cancer family health history (Palacios et al., 2021 and Krakow et al., 2020). A study conducted by Hughes Halbert et al surveyed participants to find out more information on whether those individuals were collecting their FHH from their family members. The results showed that only about 42% of participants actively worked to collect their FHH. More African American participants were found to have collected their FHH compared to White participants, but this finding was not found to be significant. In addition, participants were more likely to have collected their FHH if they had recently had a medical visit within the last year compared to those who had a medical visit more than one year prior. Lastly the study also found that women were twice as likely to have collected their FHH compared to men (Hughes Halbert et al., 2015). In another study conducted to learn more about the knowledge of families had about their FHH of type 2 diabetes, results found that communication of the FHH different between the two races looked at. The study found that African American individuals were more likely, when compared

to White participants, to have an uneven distribution of knowledge, meaning some individuals knew of the FHH and others did not (Lin et al., 2018).

Another possible obstacle to patients sharing their FHH is their perceived risk of how that information could impact their relatives' health. A study conducted by Ponder et al. examined the perceived vulnerability to common diseases based on one's family history. The results revealed that about half of the participants who reported a family history of heart disease or cancer did not perceive this as a risk for themselves to develop either disease. Participants reported that FHH was seen as more relevant for perceived risk when it came to heart disease and cancer but less so for diabetes. Lastly, women were more likely to see the presence or lack of cancer diagnoses within their FHH as relevant when thinking about their cancer risk (Ponder et al., 1996). After looking through the current research, one can see the common theme that most individuals are not aware of their FHH or the importance of knowing their FHH. These obstacles become increasingly more important to understand, especially in cases where family members do not share personal and sensitive personal health information.

1.4 Anxiety, Depression, and Hypertension

This study aims to understand the FHH communication of three conditions, hypertension, anxiety, and depression. All of these conditions are considered multifactorial and therefore not due to a monogenic cause.

Hypertension (HTN), also known as high blood pressure, is characterized by a pressure higher than 140/90 mmHg, for comparison the standard blood pressure is 120/80 mmHg (*Hypertension*, World Health Organization). Blood pressure is measured as systolic and diastolic blood pressure. Systolic represents the pressure in the blood vessels when the heart beats and

diastolic which represents the pressure in the blood vessels when the heart is at rest. There is both primary and secondary hypertension, primary HTN accounts for 90% of cases and is the onset of HTN as one gets older or due to other risk factors. While secondary HTN is the increasing of blood pressure due to an underlying condition, for example endocrine or kidney problems. HTN is a fairly common condition, affecting every 1 in 4 adults (*Hypertension*, World Heart Federation). There are a variety of risk factors for hypertension, including older age, being overweight/obese, not being physically active, high salt diet, drinking too much alcohol, and genetic factors. Hypertension is considered a multifactorial condition because there is not a single monogenic explanation for its onset. It is estimated that genetic factors contribute 30-70% of one's risk to develop HTN (Katsuya et al., 2009). Studies have found that the risk to develop HTN is twice as high when one parent is affected and almost four times as high when both parents are affected (Jang et al., 2022).

Mental illness is one of the most common conditions within the United States, with over 20% of US adults having a diagnosis (*About Mental Health*, Center for Disease Control and Prevention). Some examples of a mental illness include (but are not limited to); Anxiety, Depression, ADHD, Bipolar Disorder, Schizophrenia, Obsessive-Compulsive Disorder, and others. For the purpose of this study, the focus will be on Anxiety and Depression, two of the more common diagnoses in the US.

Anxiety is defined as "an emotion characterized by feelings of tension, worried thoughts, and physical changes" (*Anxiety*, American Psychological Association). Individuals with anxiety can have persistent and intrusive worried thoughts, may avoid situations that trigger worry, and can experience physical symptoms such as sweating, rapid heartbeat, trembling, and/or dizziness. There are a variety of disorders that are under the umbrella of anxiety, including; panic disorder,

generalized anxiety disorder (GAD), post-traumatic stress disorder (PTSD), social anxiety disorder, agoraphobia (or another phobia), obsessive-compulsive disorder (OCD), and separation anxiety disorder (*Any Anxiety Disorder*, National Institute of Mental Health). It is estimated that over 19.1% of adults in the US have a diagnosis of an anxiety disorder, with a higher prevalence occurring in females at 23.4% and males at 14.3%. Research has shown that there is a 31.6% risk for generalized anxiety disorder when a FDR has a diagnosis of GAD (Gottschalk et al., 2017).

Depression is characterized as a serious illness that affects how you feel, the way you think, and how you act (*What is Depression*, American Psychiatric Association). Individuals with depression can have feelings of sadness and/or a loss of interest in activities they usually enjoy, and it can lead to an inability to function at work or at home. About 18.4% of US adults report to have had a diagnosis of depression at some point in their life, with women being more likely to develop depression than men (Lee et al., 2023). Research supports an increased risk for depression when a FDR has a diagnosis of depression, but no certain percentage value has been agreed upon (Burcusa et al., 2007 and Halonen et al., 2021).

It is known that many individuals struggle to communicate this because it is a sensitive and personal topic with a known stigma behind the diagnosis, and one can assume that there is difficulty with sharing a new diagnosis because of the existing stigma. A recent study has shown there are two types of stigmas, first is the public-stigma, which includes the reaction that the general population has towards the diagnosis and the second is the self-stigma, which includes the prejudice one has against themselves due to the internalization of the public-stigma (Corrigan et al., 2002). It is known that culture can shape an individuals' beliefs, outlooks, values, and attitudes.

1.5 All of Us Research Program

This study is conducted using data collected by the All of Us Research Program, through the National Institute of Health. The All of Us Research Program is a longitudinal study which collects data from participants of all ages, genders/sexual orientations, and races/ethnicity (*The 'All of Us' Research Program*, 2019). The study's goal is to collect a data set that reflects the diversity within the United States and provide a data set that contains historically underrepresented groups in research. All of Us participants have the opportunity to fill out eight surveys which include, basics (demographic information), overall health, lifestyle, health care access and utilization, personal and family health history, COVID-19 participant experience, COVID-19 vaccination experience, and social determinants of health. Participants can consent to give researchers access to their electronic health record which diagnoses, drug exposures, lab and measurement, and procedure data is pulled and recorded. They also can opt in to undergoing whole genome sequencing and give their physical measurements and activity data (through wearing a Fitbit). Participants are not required to opt into all data collected, so participation size ranges depending on the data set; currently, as of April 2024, there are 410,361 participants with data accessible to researchers. All of the de-identified participant data collected is placed into a database that is accessible for researchers to gain access to the massive and diverse data set. The All of Us Research Program provides researchers with a rare and valuable opportunity to analyze datasets from a diverse and large sample size.

1.6 Overview of this Study

A central theme of this study will be examining how one's race and/or ethnicity identity interplays with one's knowledge of family health history, communication about certain

conditions within a family, and an individual's social determinants of health. There is no current research available on how SDoH can affect a patient's knowledge of their FHH and the differences in family communication depending on the medical condition. It is important to understand the race and ethnicity of a patient can impact their knowledge of FHH and comfort with sharing medical information. In addition, it is vital that we see how a patient's social determinants of health can interact with their FHH knowledge and reported presence of medical condition. This study aims to support current research by studying whether there is a significant difference between ethnic and racial groups in their knowledge of FHH. In addition, it is expected that individuals who report SDoH that align with "higher connectedness" (personally, socially, and spiritually) will report a higher knowledge of their FHH. This research aims to provide information for healthcare workers to understand how FHH knowledge differs within various communities and provide medical providers with background knowledge of the culture of patients as risk assessment is conducted. Also, it provides medical providers with data to support that all patients differ from one another, and in understanding how they may differ, it can provide medical providers with the ability to build rapport, a deeper connection, and more holistic care.

2. RESEARCH METHODS AND DESIGN

2.1 Accessing the All of Us Database

This research is based on analysis of data that are part of the All of Us Research Program, through the National Institutes of Health (*All of Us Research Program*, National Institute of Health). To access this extensive database, an account was made through the program and training was completed. The training covered the structure and values of the All of Us program, the content of the collected data, and ethical decision making when working with the data. After this was completed, the user code of conduct was signed, and access was granted to the Researcher Workbench, which allowed access to version 7 of the All of Us data collection. The Researcher Workbench contains deidentified data from participants of the program, including survey, electronic medical record, and measurements/wearables (includes physical measurements and Fitbit data). Genomics data is also available through the All of Us Research Program through the Controlled Tier training. The data that was used for this study was solely extracted from surveys which include; 'Basics', 'Personal and Family Health History', and 'Social Determinants of Health' survey.

The Researcher Workbench offers tools built for selecting groups of participants (Cohort Builder) and creating datasets ready for analysis (Dataset Builder). These enabled the use of either R or Python to complete analyses. For this study, R was utilized for data analysis.

2.2 Demographic and Descriptive Data

In the 'Basics' survey, participants of the All of Us Research Program were given the opportunity to report race and ethnicity. Participants were given the option to choose between

race; American Indian or Alaska Native, Asian, Black or African American or African, Middle Eastern or North African, Native Hawaiian of Other Pacific Islander, and White. They were also given the option to choose between ethnicity: “Not Hispanic or Latino”, “Hispanic or Latino”, report identifying with another ethnicity and/or skip the question altogether.

Within each of the categories previously mentioned, individuals were given the chance to report a more specific country or region of ancestry/origin.

Five categories were used to capture the race and ethnicity participant data in a single variable. These categories include Asian, Black, Non-Hispanic White, Hispanic/Latino, and Another Population or More than One Population.

All individuals who indicated Hispanic/Latino as their ethnicity were placed into the Hispanic/Latino category regardless of what the participant indicated for race. All other categories consisted of individuals who indicated they are Non-Hispanic/Latino and were categorized by their chosen race.

This categorization was used to maintain consistency with recommendations through the NIH (Lewis et al., 2023), other published research through the All of Us study, and for ease of comparison between US census and the All of Us demographics. Note that the race and ethnicity data are not used in this study as an indicator of ancestry, but rather as the participants’ report of cultural identification.

Age and Gender Identity were also collected from the ‘Basics’ survey. Age was split into three groups based on the All of Us categorization: 18-44, 45-64, and >65. Gender Identity was split into three groups based on the All of Us categorization; Woman, Man, and Not Man only, Not Woman only, prefer not to say/skip.

2.3 Personal and Family Health History Survey

The Personal and Family Health History survey contains 614 questions with 184,155 participant responses. For this study's purpose, only data from an initial question asking participants to rate their knowledge of their own Family Health History (FHH), the Mental Health or Substance Use and Heart and Blood Condition sections of the survey were used.

Participants were asked at the beginning of the survey how much they knew about the illnesses/health problems that affect their parents, grandparents, sister/brothers, and/or children. Individuals were given the opportunity to answer with “A lot”, “Some”, or “None at all” (also referred to as ‘None’ throughout this paper).

The survey was split into categories based on the type of condition. Participants were given the option to indicate if they had personal and/or familial diagnoses of the following types of conditions: Cancers, Heart & Blood, Digestive, Hormone & Endocrine, Kidney, Lung, Brain & Nervous System, Mental Health & Substance Use Conditions, Hearing & Eye, and Other. Once a participant indicated they had a personal and/or familial diagnosis in any of these categories, they were able to choose the specific diagnosis and indicate which individuals had the diagnosis within their family.

Participants who filled out the ‘Mental Health and Substance Use’ section of the questionnaire were given the chance to report whether they personally and/or a family member has a diagnosis of an anxiety reaction/panic disorder and/or depression. Specifically, they were given the opportunity to report if they personally had a diagnosis and/or if their mother, father, sibling, daughter, son, or grandparent had a diagnosis (Appendix I).

Participants who filled out the ‘Heart and Blood Conditions’ section of the questionnaire were given the chance to report whether they personally and/or a family member has a diagnosis

of hypertension. Specifically, they were given the opportunity to report if they personally had a diagnosis and/or if their mother, father, sibling, daughter, son, or grandparent had a diagnosis (Appendix I).

For this study's purpose, individuals who reported a grandparent diagnosis were not included in the analysis. The study only focuses on first-degree relatives (FDR) which include; parents, sisters/brothers (although the study did not ask for differentiation between full and half siblings), and children.

For each of the conditions looked at in this study, participants were categorized into four groups based on the reported personal and/or family diagnosis. The first category was 'Only Personal' which included individuals who indicated a personal diagnosis and no FDR diagnoses. The second category was 'Personal and FDR' which included participants who indicated a personal diagnosis and one or more FDR with a diagnosis. The third category was 'Only FDR' which included participants who indicated no personal diagnosis and one or more FDR with a diagnosis. The fourth category was 'None Reported/Skipped' which included participants who reported no personal and/or FDR with a diagnosis and it also included individuals who skipped the question on the survey.

2.4 Social Determinants of Health Survey

The Social Determinants of Health (SDoH) survey contains 80 questions with 117,083 participant responses. For this study's purpose, only questions about perceived stress (10 questions), support (8 questions), relationships (8 questions), and religion/spirituality (7 questions) were used. The questions and survey reference for each category are listed in Appendix II below.

These surveys were all scored separately based on the reference survey from which each set of questions originated. Below is a further explanation of the scoring.

The questions in the Perceived Stress category included five possible answers range from 'Never' to 'Very Often'. For questions 1-3, 6, 9, and 10 the answers were scored on a range from 0-4, 0=Very Often, 1=Fairly Often, 2=Sometimes, 3=Almost Never, and 4=Never. For questions 4, 5, 7, and 8 the scoring was inversed so 0=4, 1=3, and 2=2 . Higher scores within the Perceived Stress category represent lower levels of perceived stress at the time the participant completes the survey (Cohen et al., 1983).

The questions in the Support category included five possible answers range from 'None of the time' to 'All of the time'. For all questions the answers were scored on a range from 1-5, 1=None of the time, 2=A little of the time, 3=Some of the time, 4=Most of the time, and 5=All of the time. Higher scores within the Support category represent higher levels of support within the participant's life (Sherbourne et al., 1991).

The questions in the Relationships category included four possible answers range from 'Never' to 'Often'. For questions 1, 2, 4, 5, and 8 the answers were scored on a range from 0-3, 0=Often, 1=Sometimes, 2=Rarely, and 3=Often. For questions 3, 6, and 7 the scoring was inversed so that 0=3 and 1=2. Higher scores in the Relationships category represent the presence and a higher quality of relationship within the participant's life (Sherbourne et al., 1991).

All of the questions in the Religion and Spirituality category included the possibility to choose an answer ranging from 'Never or almost never' to 'Many times a day', with the following scoring: 1-6, 1=Never or almost never, 2=Once in a while, 3=Some days, 4=Most days, 5=Every day, and 6=Many times a day. Questions 1, 4 and 5 also included the option to select 'I do not believe in God (or a higher power)' (scored as 0), and question 2 included the

option to select ‘I am not religious’ (scored as 0). Higher scores within the Religion and Spirituality category represent more experience with religion and spirituality (*Multidimensional Measurement of Religiousness/Spirituality*, Fetzer Institute).

2.5 Data Table Configuration and Statistical Analysis

The variables identified for analysis were isolated using the All of Us Researchers Workbench and loaded into R where analysis was completed. Statistical analysis of the data included chi^2 contingency tables, ANOVAs, and post-hoc tests to determine significance of data ($p<0.05$). Contingency tables (with chi-square analysis) were constructed to test for association between categorical variables. For continuous variables, analysis of variance was used to compare the mean between two or more groups. When a significant difference in the mean was identified based on grouping for a categorical variable with more than two groups, post-hoc tests were used to determine which comparisons contributed to the significant finding. A nominal p-value is reported for each statistical test, with no correction for multiple comparisons.

3. RESULTS

3.1 All of Us Descriptive Data

The All of Us program currently, as of April 2024, has a total of 410,361 participants whose data is available in the researcher's workbench for extraction and analysis. Of the participants; 394,322 identified their Race and Ethnicity, 407,333 identified their current age, and 410,264 identified their gender identity. This demographic and descriptive data is presented in Table 2. The data in the table summarizes participants who completed the Family Health History (FHH) Survey, and participants who completed the Social Determinants of Health (SDoH) Survey. Those who skipped questions about their Race and Ethnicity, Age, or Gender Identity are not included within Table 2. Race and ethnicity extracted from the 2022 US Census is included in the table as a comparator.

Table 2. Demographic and descriptive data from the Surveys compared with 2022 US Census data (U.S. Census Bureau, 2022).

	***All of Us* Overall[a]**	**FHH Survey[a]**	**SDoH Survey[a]**	**US Census**
Race and Ethnicity	n=394,322 n(%)	n=176,855 n(%)	n=111,982 n(%)	n=334,914,895
Asian	13,785 (3.5%)	6,075 (3.4%)	3,109 (2.8%)	6.3%
Black	76,886 (19.5%)	16,882 (9.5%)	8,965 (8.0%)	13.6%
Hispanic/Latino(a)	73,945 (18.8%)	21,360 (12.1%)	10,300 (9.2%)	19.1%
Non-Hispanic White	220,116 (55.8%)	128,151 (72.5%)	87,210 (77.9%)	58.9%
Another Population or More than One Population (Non-Hispanic/Latino(a))	9,590 (2.4%)	4,387 (2.5%)	2,398 (2.1%)	4.6%
Age	n=407,333	n=183,436	n=116,908	
18-44 years	125,883 (30.9%)	51,212 (27.9%)	25,339 (21.7%)	
45-64 years	142,921 (35.1%)	59,103 (32.2%)	36,829 (31.5%)	
> 65 years	138,529 (34.0%)	73,121 (39.9%)	54,740 (46.8%)	
Gender Identity	n=410,264	n=184,155	n=117,023	
Man	152,142 (37.1%)	61,284 (33.3%)	39,514 (33.8%)	
Woman	248,130 (59.9%)	116,543 (63.3%)	73,109 (62.5%)	
Not Man only, Not Woman only, prefer not to say/skip	4,366 (3.1%)	6,328 (3.4%)	4,400 (3.8%)	

a. Overall n is different for each group (Race and Ethnicity, Age, and Gender Identity) due to participants being able to skip or decline to answer a question

Table 3 summarizes the demographic and descriptive data for those who completed both the SDoH and FHH survey, only one of these surveys, and neither. It was found that 99,737 *All of Us* participants completed both the SDoH and FHH surveys, 12,245 completed only the SDoH survey and not the FHH Survey, 77,118 participants completed the FHH survey and not the SDoH survey, and 205,222 participants completed neither survey.

Table 3. Demographic and descriptive data comparing participants who completed and did not complete Social Determinants of Health (SDoH) and Family Health History (FHH) surveys.

	SDoH and FHH[a]	**Only SDoH[a]**	**Only FHH[a]**	**Neither[a]**
Race and Ethnicity[b]	n=99,737 n (%)	n=12,245 n (%)	n=77,118 n (%)	n=205,222 n (%)
Asian	2,726 (2.7%)	383 (3.1%)	3,349 (4.3%)	7,327 (3.6%)
Black	7,186 (7.2%)	1,779 (14.5%)	9,696 (13.6%)	58,225 (28.4%)
Hispanic/Latino(a)	8,509 (8.5%)	1,791 (14.6%)	12,851 (16.7%)	50,794 (24.8%)
Non-Hispanic White	79,168 (79.4%)	8,042 (65.7%)	48,983 (63.5%)	83,923 (40.9%)
Another Population or More than One Population (Non-Hispanic/Latino(a))	2,148 (2.2%)	250 (2.0%)	2,239 (2.9%)	4,953 (2.4%)
Age[c]	n=104,142	n=12,766	n=79,294	n=211,131
18-44 years	22,639 (21.7%)	2,700 (21.1%)	28,573 (36.0%)	71,971 (34.1%)
45-64 years	32,860 (31.6%)	3,969 (31.1%)	26,243 (33.1%)	79,849 (37.8%)
> 65 years	48,643 (46.7%)	6,097 (47.8%)	24,478 (30.9%)	59,311 (28.1%)
Gender Identity[d]	n=104,239	n=12,784	n=79,916	n=213,325
Man	34,914 (33.5%)	4,600 (36.0%)	26,370 (33.0%)	86,258 (40.4%)
Woman	65,328 (62.7%)	7,781 (60.9%)	51,215 (64.1%)	121,277 (56.9%)
Not Man only, Not Woman only, prefer not to say/skip	3,997 (3.8%)	403 (3.2%)	2,331 (2.9%)	5,790 (2.7%)

a. Overall n is different for each group (Race and Ethnicity, Age, and Gender Identity) due to participants being able to skip or decline to answer a question.
b. χ^2=47,433.4 (12 df), p<0.00001.
c. χ^2=1,3611.1 (6 df), p<0.00001.
d. χ^2= 2,367.3 (6 df), p<0.00001

Table 4 focuses on comparing the demographic and descriptive data of those who completed and did not complete the FHH and SDoH surveys. It was found that 184,155 participants completed the FHH survey and 226,206 did not complete the FHH survey. In addition, 117,023 participants completed the SDoH survey and 282,340 participants did not complete the SDoH survey. Within the descriptive data, those that skipped Race and Ethnicity, Age, or Gender Identity questions were not included. Analysis was completed to compare those that completed the survey and those that did not complete the survey. For the FHH and SDoH Surveys, there was a significant difference between those who did and did not complete the surveys, by Race and Ethnicity ($p<0.00001$), Age ($p<0.00001$), and Gender Identity ($p<0.00001$). A majority (58.2%) of Non-Hispanic White participants completed the FHH survey; for all other race and ethnicities, individuals were more likely to not complete it ($p<0.00001$). Individuals over 65 were more likely to complete the survey than not complete it, the opposite was seen for individuals younger than 65 ($p<0.00001$). Lastly, the gender identity category showed that individuals who identified as Not Man only, Not Woman only, prefer not to say/skip were more likely to complete the survey than not, and those that identified as a woman or a man were more likely to not complete the survey ($p<0.00001$). For the SDoH Survey all groups in Race and Ethnicity, Age, and Gender Identity were more likely to not complete the survey than to complete it, and there was a significant difference between those who did and did not complete the survey, for each of these variables ($p<0.00001$).

Table 4. Demographic and descriptive data comparing participants who completed and did not complete All of Us surveys.

	FHH Survey	
	Completed[a]	**Not Completed[a]**
Race and Ethnicity[b]	n=176,855 n (%)	n=217,467 n (%)
Asian	6,075 (44.1%)	7,710 (55.9%)
Black	16,882 (22.0%)	60,004 (78.0%)
Hispanic/Latino(a)	21,360 (28.9%)	52,585 (71.1%)
Non-Hispanic White	128,151 (58.2%)	91,965 (41.8%)
Another Population or More than One Population (Non-Hispanic/Latino(a))	4,387 (45.7%)	5,203 (54.3%)
Age[c]	n=183,436	n=223,897
18-44 years	51,212 (40.7%)	74,671 (59.4%)
45-64 years	59,103 (41.4%)	83,818 (58.6%)
> 65 years	73,121 (52.8%)	65,408 (47.2%)
Gender Identity[d]	n=184,155	n=226,109
Man	61,284 (40.3%)	90,858 (59.7%)
Woman	116,543 (47.5%)	129,058 (52.5%)
Not Man only, Not Woman only, prefer not to say/skip	6,328 (50.5%)	6,193 (49.5%)
	SDoH Survey	
	Completed[a]	**Not Completed[a]**
Race and Ethnicity[e]	n=111,982	n=282,340
Asian	3,109 (22.6%)	10,676 (77.4%)
Black	8,965 (11.7%)	67,921 (88.3%)
Hispanic/Latino(a)	10,300 (13.9%)	63,645 (86.1%)
Non-Hispanic White	87,210 (39.6%)	132,906 (60.4%)
Another Population or More than One Population (Non-Hispanic/Latino(a))	2,398 (25.0%)	7,192 (75.0%)
Age[f]	n=116,908	n=290.425
18-44 years	25,339 (20.1%)	100,544 (79.9%)
45-64 years	36,829 (25.8%)	106,092 (74.2%)
> 65 years	54,740 (39.5%)	83,789 (60.5%)
Gender Identity[g]	n=117,023	n=293,241
Man	39,514 (26.0%)	113,628 (74.0%)
Woman	73,109 (29.8%)	172,492 (70.2%)
Not Man only, Not Woman only, prefer not to say/skip	4,400 (35.1%)	8,121 (60.5%)

a. Overall n is different for each group (Race and Ethnicity, Age, and Gender Identity) due to participants being able to skip or decline to answer a question.
b. χ^2=39822.6 (4 df), p<0.00001.
c. χ^2=5106.4 (2 df), p<0.00001.
d. χ^2=2119.8 (2 df), p<0.00001.
e. χ^2=32134.5 (4 df), p<0.00001.
f. χ^2=13037.4 (2 df), p<0.00001.
g. χ^2=1012.1 (2 df), p<0.00001.

3.2 Knowledge of Family Health History

Data below is extracted from the Family Health History (FHH) survey. Table 5 specifically references one question asked at the beginning of the survey; “How much do you know about the illnesses or health problems for your parents, grandparents, brothers, sisters, and/or children?” Participants are given the opportunity to answer they know ‘A Lot’, ‘Some’, or ‘None at all.’ Participants were also given the option to skip the FHH questions altogether; those participants are not included. Table 5 includes the demographic and descriptive data for participants who reported they know ‘A Lot’, ‘Some’, or ‘None at all’ about their FHH. Table 5 shows that the greatest number of individuals answered ‘Some’, followed by ‘A Lot’, and lastly the least amount of individuals answered, ‘None at all.’ There were significant associations found between Knowledge of FHH and Race and Ethnicity ($p<0.00001$), Age ($p<0.00001$), and Gender Identity ($p<0.00001$). Those who identified as Non-Hispanic White were most likely to report knowing a lot about their FHH (37.8%) and those who identified as Asian were least likely to report knowing a lot (28.8%). Individuals who were 18-44 years old were more likely to report knowing nothing at all about their family history (5.2%), in comparison to individuals in the 45-64 year old (4%) or those greater than 65 years old (2.2%). Those who were greater than 65 years old were most likely to report knowing a lot about their FHH (38.2%), while those who were 18-44 years old were least likely to report knowing a lot (29.3%). There was a significant association between reported gender and knowledge of FHH (chi squared, 4, $p<0.00001$). Males were more likely to reported knowing nothing about their family history (4.6%) compared to females (3.1%). For those who reported knowing a lot about their FHH, Females made up the largest group at 38.43% and Males made up the smallest group at 30.65%.

Table 5. Demographic and descriptive data: Relationships of Reported Knowledge of Family Health History (FHH).

	A Lot[a]	Some[a]	None at All[a]
Race and Ethnicity[b]	n=61,790	n=105,260	n=6,216
Asian	1,707 (28.8%)	3,856 (65.0%)	369 (6.2%)
Black	4,862 (29.6%)	9,946 (60.5%)	1,632 (9.9%)
Hispanic/Latino(a)	6,192 (30.3%)	12,855 (62.8%)	1,421 (6.9%)
Non-Hispanic White	47,691 (37.8%)	75,852 (60.1%)	2,605 (2.1%)
Another Population or More than One Population (Non-Hispanic/Latino(a))	1,338 (31.3%)	2,751 (64.3%)	189 (4.4%)
Age[c]	n=63,982	n=109,207	n=6,509
18-44 years	14,589 (29.3%)	32,552 (65.4%)	2,595 (5.2%)
45-64 years	21,928 (37.8%)	33,793 (58.2%)	2,314 (4.0%)
> 65 years	27,465 (38.2%)	42,862 (59.6%)	1,600 (2.2%)
Gender Identity[d]	n=64,244	n=109,621	n=6,532
Man	18,394 (30.7%)	38,876 (64.8%)	2,748 (4.6%)
Woman	43,885 (38.4%)	66,781 (58.5%)	3,531 (3.1%)
Not Man only, Not Woman only, prefer not to say/skip	1,954 (31.8%)	3,964 (64.1%)	253 (4.1%)

a. Overall n is different for each group (Race and Ethnicity, Age, and Gender Identity) due to participants being able to skip or decline to answer a question.
b. χ^2=4,505.7 (8 df), p<0.00001.
c. χ^2=1,777.4 (4 df), p<0.00001.
d. χ^2=1,210.3 (4 df), p<0.00001

Three medical conditions were included in this study for analysis of personal and/or familial presence of each condition: anxiety, depression, and hypertension (HTN). For the purpose of this study, only information about first degree relatives (FDR) is used; including parents, brothers, sisters, and children. Figure 1 summarizes the personal and/or familial presence for each of the three conditions based on how much FHH knowledge participants reported having about their family. The percent of the participants who reported a familial diagnosis of each condition was highest in the group which reported knowledge of FHH as "A lot", lower in the group reporting "Some" knowledge of FHH, and lowest in those who reported "None at all" for knowledge of FHH. This difference was significant for each condition ($p<0.00001$), and the pattern was the same for each condition. Some individuals who reported knowing nothing about their FHH still reported the presence of these conditions in their FDRs; Anxiety (2%), Depression (3%), and HTN (5%).

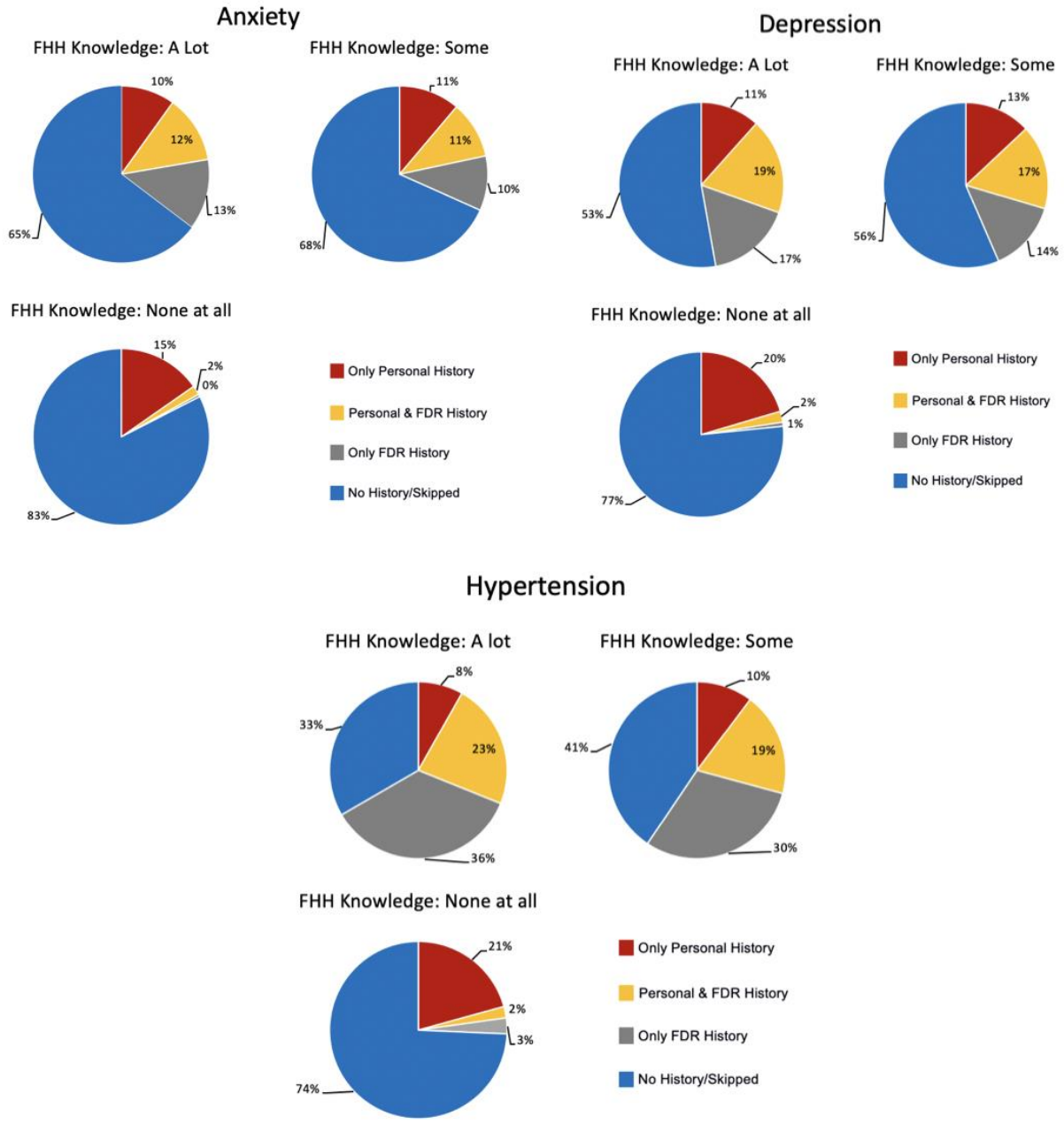

Figure 1. Reported Knowledge of Family Health History (FHH) in those with a Presence of Personal and/or First Degree Relative (FDR) Anxiety, Depression, and Hypertension. Reported Knowledge of FHH in those with Personal and/or First Degree Relative (FDR) Anxiety (left), Depression (middle), and Hypertension (right). Participants reported either A Lot (n=64,244), Some (n=109,621), or None at all (n=6,532) when asked about their Knowledge of FHH. There was a significant difference in the presence of personal and/or family history of each condition between the different groups by level of FHH knowledge (Anxiety: χ^2=2,146.9 (6 df), p<0.00001, Depression: χ^2=3,079.6 (6 df), p<0.00001, and HTN: χ^2=7,136.9 (6 df), p<0.00001).

3.3 Social Determinants of Health related to Support, Relationships, Perceived Stress, and Religion and Spirituality

The Social Determinants of Health survey (SDoH) consists of questions asking *All of Us* participants about their neighborhood, social life, perceived stress, and feelings about everyday life. This study focused on the response to questions from four categories: support (8 questions), relationships (8 questions), perceived stress (10 questions), and religion and spirituality (6 questions). The scoring for each category was derived from previous research studies ((Cohen et al., 1983, Sherbourn et al., 1991, and *Multidimensional Measurement of Religiousness/Spirituality*, Fetzer Institute). Higher SDoH scores refer to more support in one's life, good relationships with others, lower levels of stress and being able to handle stress effectively, and experiencing religion and spirituality in everyday life. The support category is scored from 1-5, relationships is scored from 0-3, perceived stress is scored from 0-4, and religion and spirituality is scored from 1-6. As an overview, Table 6a-d summarizes the sample size, and SDoH scores for the demographic subgroups. Non-Hispanic white individuals were found to have the highest average SDoH score in support ($p<0.05$), relationship ($p<0.05$), and perceived stress ($p<0.2$) categories while Black individuals had the highest average SDoH score in religion and spirituality ($p<0.05$). Those who were 18-44 years old had the highest score in the support category ($p<0.05$), while those older than 65 had the highest scores in the relationships ($p<0.05$), perceived stress ($p<0.05$, and religion and spirituality ($p<0.05$) categories. Lastly, those that identified as men had the highest scores in the support ($p<0.05$), relationships ($p<0.05$), and perceived stress ($p<0.05$) categories and those that identified as women had the highest score in religion and spirituality ($p<0.05$).

Table 6a. Support Social Determinant of Health (SDoH) score and relationship to demographics and descriptive data

	Sample Size	Support
Race and Ethnicity[a]		
Asian	n= 3,109	3.79 ± 1.21
Black	n= 8,965	3.63 ± 1.34
Hispanic/Latino(a)	n=10,300	3.71 ± 1.29
Non-Hispanic White	n=87,210	3.93 ± 1.18
Another Population or More than One Population (Non-Hispanic/Latino(a))	n= 2,398	3.83 ± 1.25
Age[b]		
18-44 years	n=25,339	3.98 ± 1.16
45-64 years	n=36,829	3.83 ± 1.23
> 65 years	n=54,740	3.86 ± 1.22
Gender Identity[c]		
Man	n=39,514	3.87 ± 1.24
Woman	n=73,109	3.86 ± 1.19
Not Man only, Not Woman only, prefer not to say/skip	n= 4,400	3.75 ± 1.27

a. F(4,111977)=1467, p<0.0001, all post-hoc showed p<0.05.
b. F(2,116905)=918812, p<0.00001, all post-hoc showed p<0.05.
c. F(2,117020)=239.7, p<0.0001, all post-hoc showed p<0.05. ± signifies standard deviation.

Table 6b. Relationships Social Determinant of Health (SDoH) score and relationship to demographics and descriptive data

	Sample Size	Relationships
Race and Ethnicity[a]		
Asian	n= 3,109	2.01 ± 0.90
Black	n= 8,965	2.02 ± 1.01
Hispanic/Latino(a)	n=10,300	2.08 ± 0.96
Non-Hispanic White	n=87,210	2.08 ± 0.91
Another Population or More than One Population (Non-Hispanic/Latino(a))	n= 2,398	1.97 ± 0.95
Age[b]		
18-44 years	n=25,339	1.92 ± 0.94
45-64 years	n=36,829	2.02 ± 0.95
> 65 years	n=54,740	2.17 ± 0.89
Gender Identity[c]		
Man	n=39,514	2.12 ± 0.92
Woman	n=73,109	2.06 ± 0.92
Not Man only, Not Woman only, prefer not to say/skip	n= 4,400	1.85 ± 1.00

a. F(4,111977)=158, p<0.001.
b. F(2,116905)=208 ,p<0.0001, all post-hoc showed p<0.05.
c. F(2,117020)=1424 ,p<0.0001, all post-hoc showed p<0.05. ± signifies standard deviation.

Table 6c. Perceived Stress Social Determinant of Health (SDoH) score and relationship to demographics and descriptive data

	Sample Size	Perceived Stress
Race and Ethnicity[a]		
Asian	n= 3,109	2.53 ± 0.95
Black	n= 8,965	2.52 ± 1.04
Hispanic/Latino(a)	n=10,300	2.45 ± 1.03
Non-Hispanic White	n=87,210	2.68 ± 0.93
Another Population or More than One Population (Non-Hispanic/Latino(a))	n= 2,398	2.42 ± 1.02
Age[b]		
18-44 years	n=25,339	2.21 ± 1.07
45-64 years	n=36,829	2.51 ± 0.98
> 65 years	n=54,740	2.92 ± 0.83
Gender Identity[c]		
Man	n=39,514	2.82 ± 0.90
Woman	n=73,109	2.55 ± 0.97
Not Man only, Not Woman only, prefer not to say/skip	n= 4,400	2.35 ± 1.08

a. F(4,111977)=80647, p<0.00001.
b. F(2,116905)=196395, p<0.00001, all post-hoc showed p<0.05
c. F(2,117020)=172058, p<0.00001, all post-hoc showed p<0.05. ± signifies standard deviation.

Table 6d. Religion and Spirituality Social Determinant of Health (SDoH) score and relationship to demographics and descriptive data

	Sample Size	Religion and Spirituality
Race and Ethnicity[a]		
Asian	n= 3,109	2.69 ± 1.95
Black	n= 8,965	4.55 ± 1.55
Hispanic/Latino(a)	n=10,300	3.64 ± 1.93
Non-Hispanic White	n=87,210	3.02 ± 2.03
Another Population or More than One Population (Non-Hispanic/Latino(a))	n= 2,398	2.94 ± 2.08
Age[b]		
18-44 years	n=25,339	2.58 ± 1.87
45-64 years	n=36,829	3.31 ± 2.00
> 65 years	n=54,740	3.39 ± 2.02
Gender Identity[c]		
Man	n=39,514	2.97 ± 2.05
Woman	n=73,109	3.33 ± 2.01
Not Man only, Not Woman only, prefer not to say/skip	n= 4,400	2.80 ± 2.07

a. F(4,111977)=8546, p<0.00001, all post-hoc showed p<0.05.
b. F(2,116905)=18876, p<0.00001, all post-hoc showed p<0.05.
c. F(2,117020)=2966, p<0.00001, all post-hoc showed p<0.05. ± signifies standard deviation.

3.3.1 Social Determinants of Health and Reported Knowledge of Family Health History

The analyses summarized in the following pages explore the two-way relationship between SDoH and reported knowledge of FHH, and the two-way relationship between SDoH and the presence of personal and/or familial anxiety, depression, and hypertension. In addition, the three-way relationship between SDoH, reported knowledge of FHH, and the presence of personal and/or familial anxiety, depression, and hypertension is summarized. These analyses were completed to explore whether a relationship between SDoH and knowledge of FHH exists and whether that relationship is impacted based on the medical condition present (or absent) within the individual or family.

The relationship between SDoH and reported knowledge of FHH is shown in Table 7 and Figure 2. For all of the SDoH domains analyzed (except for Religion and Spirituality), the SDoH scores differed significantly between the groups based on reported knowledge of FHH. In SDoH domains of Support, Relationships, and Perceived Stress higher SDoH scores were seen in individuals who reported more knowledge of FHH. An ANOVA identified a significant difference in SDoH score between the groups based on knowledge of FHH for all SDoH categories: Support ($F(3,103964)=2313$, $p<0.00001$), Relationships ($F(3,103964)=3532$, $p<0.00001$), and Perceived Stress ($F(3,103964)=101094$, $p<0.00001$). Post-hoc tests identified significance difference ($p<0.00001$) between all groups based on knowledge of FHH. In Religion and Spirituality, the pattern seen in the other groups was not identified. Individuals who reported knowing “A lot” and “None at all” about their FHH had the same SDoH score (3.36) and those who reported “Some” knowledge had a lower SDoH Score (3.04). An ANOVA showed significance ($F(3,103964)=1223$, $p<0.001$) but post hoc test showed a significant difference between all categories except A Lot and None at all ($p<0.65$).

Table 7. Average Social Determinant of Health (SDoH) score and Relationship to Reported Knowledge of Family Health History

		Support[a]	Relationships[b]	Perceived Stress[c]	Religion and Spirituality[d]
Reported Knowledge of FHH					
A Lot	n=38,429	4.02 ± 1.15	2.16 ± 0.90	2.71 ± 0.93	3.36 ± 2.05
Some	n=62,272	3.84 ± 1.21	1.93 ± 1.00	2.62 ± 0.95	3.04 ± 2.03
None at all	n=2,642	3.50 ± 1.41	1.90 ± 1.03	2.43 ± 1.10	3.36 ± 2.06

a. F(3,103964)=2313, p<0.00001, all post-hoc showed p<0.05.
b. F(3,103964)=3532, p<0.00001, all post-hoc showed p<0.05.
c. F(3,103964)=101094, p<0.00001, all post-hoc showed p<0.05.
d. F(3,103964)=1223, p<0.001. ± signifies standard deviation.

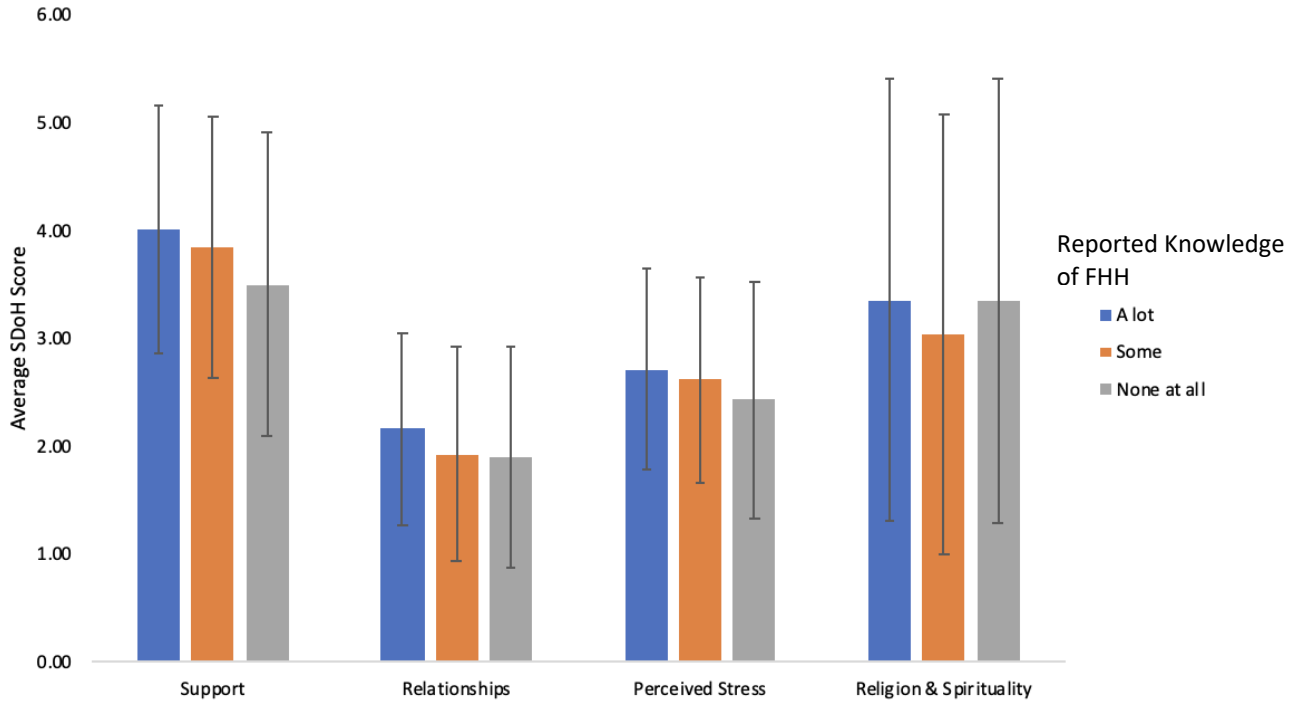

Figure 2. Average Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH). SDoH survey participants who reported their level of knowledge of FHH as A lot (n=38,424), Some (n=62,255), or None at all (n=2,633). Average SDoH of each group was taken and segregated based on SDoH questions answered. SDoH categories included support (questions scored 1-5), relationships (0-3), perceived stress (0-4), and religion/spirituality (0-6). Error bars show the standard deviation. The ANOVA determined significance and post hoc showed significance (p<0.00001) for each group excluding significance between A lot and None at all for Religion/Spirituality SDoH category.

3.3.2 Social Determinants of Health and Reported Anxiety

The relationship between SDoH and personal and/or familial presence, or absence, of anxiety is shown in the data contained in Table 8 and Figure 3. ANOVA statistical analysis was run and showed significance within all SDoH categories: Support ($p<0.00001$), Relationships ($p<0.00001$), Perceived Stress ($p<0.00001$), and Religion and Spirituality ($p<0.00001$). In all SDoH categories looked at higher average SDoH scores were found in groups where no personal anxiety was reported ($p<0.00001$), when compared to groups with personal anxiety reported. Within categories where personal anxiety was reported, Only Personal and Personal and FDR, significance was found in Support ($p<0.00001$) and Perceived Stress ($p<0.0001$) but was not found in Relationships ($p=0.25$) and Religion and Spirituality ($p=0.39$). Within categories where personal anxiety was not reported, Only FDR and None Reported/Skipped, significance was found in all four SDoH categories ($p<0.0001$).

Table 8. Average Social Determinant of Health (SDoH) score for Personal and/or Familial Presence of Anxiety.

		Support[a]	Relationships[b]	Perceived Stress[c]	Religion and Spirituality[d]
Anxiety Reported					
Only Personal	n=10,867	3.70 ± 1.28	1.79 ± 0.98	2.20 ± 1.08	2.89 ± 2.01
Personal and FDR	n=12,036	3.79 ± 1.23	1.78 ± 0.98	2.09 ± 1.10	2.90 ± 1.99
Only FDR	n=11,420	4.00 ± 1.13	2.11 ± 0.89	2.65 ± 0.90	3.18 ± 2.02
None Reported/Skipped	n=82,700	3.90 ± 1.21	2.14 ± 0.90	2.77 ± 0.90	3.27 ± 2.04

a. F(3,117019)=1096, p<0.00001, all post-hoc showed p<0.05. b. F(3,117019)=7340, p<0.00001, all post-hoc showed p<0.05 except between Only Personal and Personal and FDR (p=0.25). c. F(3,117019)=111843, p<0.00001, all post-hoc showed p<0.05. d. F(3,117019)=1226, p<0.00001, all post-hoc showed p<0.05 except between Only Personal and Personal and FDR (p=0.39). ± signifies standard deviation.

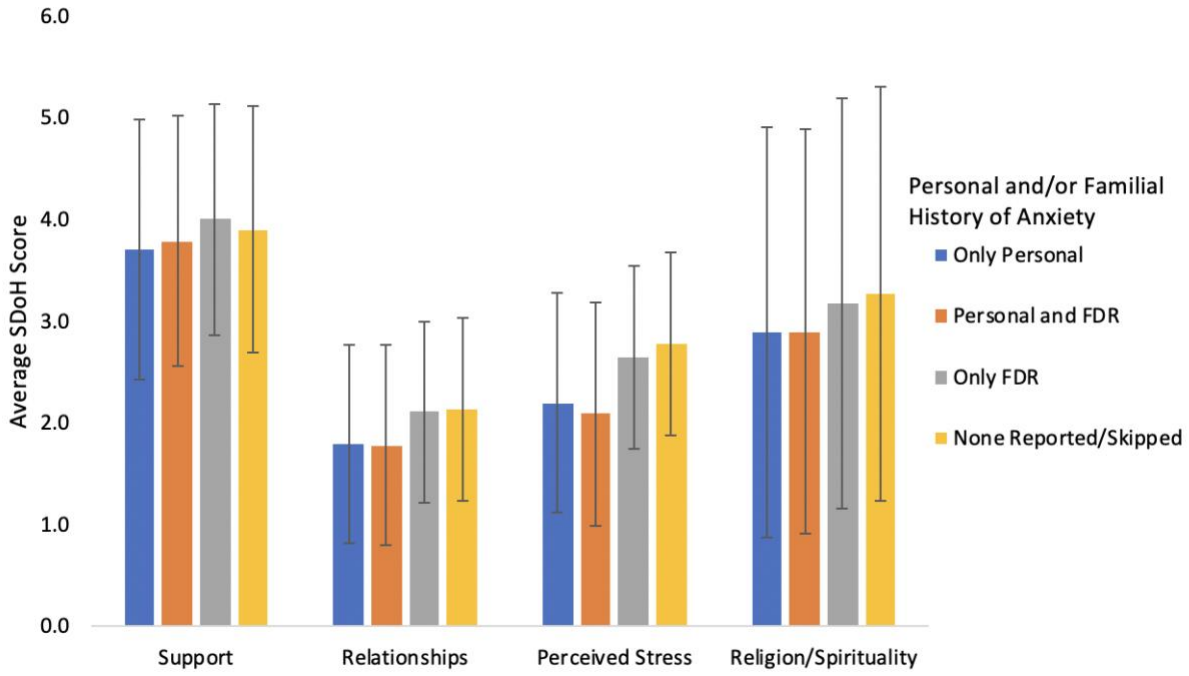

Figure 3. Average Social Determinant of Health (SDoH) score for Personal and/or Familial Presence of Anxiety. SDoH survey participants who reported presence of Only Personal Anxiety (n=10,867), Personal and First Degree Relative (FDR) Anxiety (n=12,036), Only FDR Anxiety (n=11,420), or no Personal and/or FDR Anxiety/Skipped the question altogether (n=82,700). Average SDoH of each group was taken and segregated based on SDoH questions answered. SDoH categories included support (questions scored 1-5), relationships (0-3), perceived stress (0-4), and religion/spirituality (0-6).

3.3.3 Social Determinants of Health and Reported Depression

The relationship between SDoH and personal and/or familial presence, or absence, of depression is shown in the data contained in Table 9 and Figure 4. An ANOVA was run to evaluate where there was a different in SDoH score based on the personal and/or familial presence of depression. A significant relationship was found for all SDoH categories: Support ($p<0.00001$), Relationships ($p<0.00001$), Perceived Stress ($p<0.00001$), and Religion and Spirituality ($p<0.00001$). In all SDoH categories looked at higher average SDoH scores were found in groups where no personal depression was reported ($p<0.00001$), when compared to groups with personal depression reported. Within categories personal depression was reported, Only Personal and Personal and FDR, significance was found in all four SDoH groups ($p<0.00001$). Within categories where personal depression was not reported, Only FDR and None Reported/Skipped, significance was found in all four SDoH groups ($p<0.00001$).

Table 9. Average Social Determinant of Health (SDoH) score for Personal and/or Familial Presence of Depression

		Support[a]	Relationships[b]	Perceived Stress[c]	Religion and Spirituality[d]
Depression Reported					
Only Personal	n=13,031	3.66 ± 1.29	1.79 ± 0.98	2.33 ± 1.04	2.94 ± 2.03
Personal and FDR	n=19,277	3.74 ± 1.24	1.75 ± 0.98	2.18 ± 1.08	2.89 ± 2.00
Only FDR	n=15,182	4.04 ± 1.12	2.16 ± 0.97	2.73 ± 0.88	3.15 ± 2.04
None Reported/Skipped	n=69,533	3.92 ± 1.20	2.19 ± 0.88	2.80 ± 0.89	3.33 ± 2.03

a. F(3,117019)=2728, p<0.00001, all post-hoc showed p<0.05.
b. F(3,117019)=12765, p<0.00001, all post-hoc showed p<0.05.
c. F(3,117019)=111843, p<0.00001, all post-hoc showed p<0.05.
d. F(3,117019)=1823, p<0.00001, all post-hoc showed p<0.05. ± signifies standard deviation.

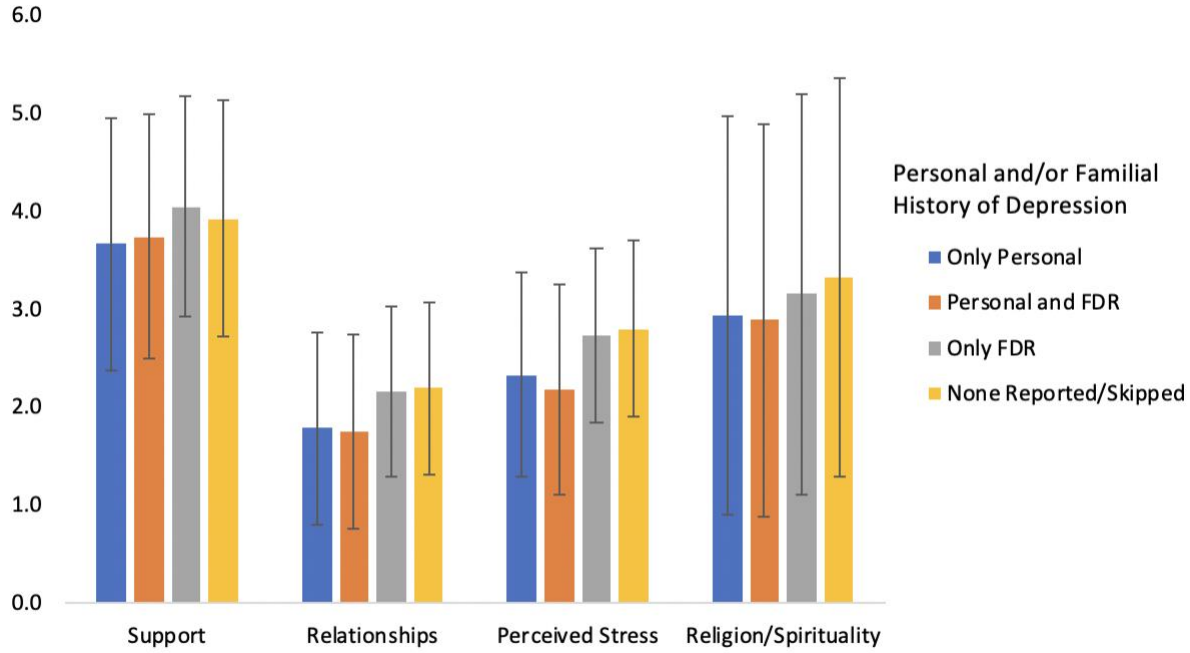

Figure 4. Average Social Determinant of Health (SDoH) score for Personal and/or Familial Presence of Depression. SDoH survey participants who reported presence of Only Personal Depression (n=13,031), Personal and First Degree Relative (FDR) Depression (n=19,277), Only FDR Depression (n=15,182), or no Personal and/or FDR Depression/Skipped the question altogether (n=69,533). Average SDoH of each group was taken and segregated based on SDoH questions answered. SDoH categories included support (questions scored 1-5), relationships (0-3), perceived stress (0-4), and religion/spirituality (0-6).

3.3.4 Social Determinants of Health and Reported Hypertension

The relationship between SDoH and personal and/or familial presence, or absence, of hypertension is shown in the data contained in Table 10 and Figure 5. ANOVA statistical analysis was run and showed significance within all SDoH categories; Support ($p<0.00001$), Relationships ($p<0.01$), Perceived Stress ($p<0.00001$), and Religion and Spirituality ($p<0.00001$). In the Support SDoH categories higher average SDoH scores were found in groups where no personal HTN was reported ($p<0.00001$), when compared to groups with personal HTN reported. In the Perceived Stress and Religion and Spirituality category higher SDoH scores were found in groups where personal HTN was reported ($p<0.00001$), when compared to groups with no personal HTN was reported. Within categories where personal HTN was reported, Only Personal and Personal and FDR, significance was found in Support, Perceived Stress, and Religion and Spirituality SDoH groups ($p<0.00001$). Within categories where personal HTN was not reported, Only FDR and None Reported/Skipped, significance was found in all Support, Perceived Stress, and Religion and Spirituality SDoH groups ($p<0.00001$). The Relationships category showed neither relationship discussed above. Significant was only found in the post-hoc test between None Reported/Skipped and Only FDR and None Reported/Skipped and Personal and FDR.

Table 10. Average Social Determinant of Health score for Personal and/or Familial Presence of Hypertension

		Support[a]	Relationships[b]	Perceived Stress[c]	Religion and Spirituality[d]
Hypertension Reported					
Only Personal	n=10,236	3.74 ± 1.28	2.07 ± 0.94	2.77 ± 0.92	3.27 ± 2.04
Personal and FDR	n=23,129	3.84 ± 1.23	2.06 ± 0.94	2.68 ± 0.95	3.39 ± 2.00
Only FDR	n=32,767	3.97 ± 1.15	2.06 ± 0.91	2.58 ± 0.96	3.07 ± 2.04
None Reported/Skipped	n=50,891	3.86 ± 1.22	2.08 ± 0.93	2.63 ± 0.96	3.16 ± 2.04

a. F(3,117019)=996, p<0.00001, all post-hoc showed p<0.05.
b. F(3,117019)=17.4, p<0.01, only post-hoc between None Reported/Skipped and Only FDR and None Reported/Skipped and Personal and FDR showed (p<0.05), all others were not found to be significant (p>0.05).
c. F(3,117019)=111843, p<0.00001, all post-hoc showed p<0.05.
d. F(3,117019)=708, p<0.00001, all post-hoc showed p<0.05. ± signifies standard deviation.

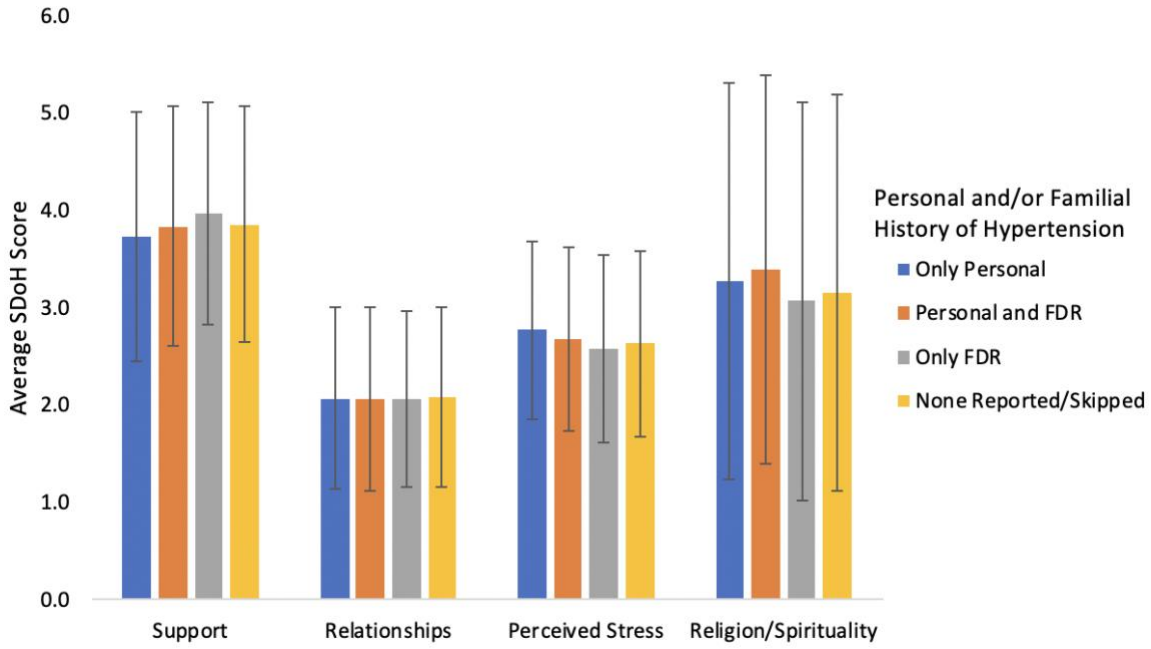

Figure 5. Average Social Determinant of Health (SDoH) score for Personal and/or Familial Presence of Hypertension. SDoH survey participants who reported presence of Only Personal Hypertension (n=10,236), Personal and First Degree Relative (FDR) Hypertension (n=23,129), Only FDR Hypertension (n=32,767), or no Personal and/or FDR Hypertension/Skipped the question altogether (n=50,891). Average SDoH of each group was taken and segregated based on SDoH questions answered. SDoH categories included support (questions scored 1-5), relationships (0-3), perceived stress (0-4), and religion/spirituality (0-6).

3.4 Multivariate Relationship of Social Determinant of Health, Knowledge of Family Health History, and Presence of Anxiety, Depression, or Hypertension

The relationship between SDoH and presence of a medical condition was examined separately for those who indicated “A Lot” of knowledge of FHH, “Some” knowledge, or “None at all.” Similar patters to those discussed above were found for each of these subgroups. More detailed explanations of the results can be found in Appendix III.

4. DISCUSSION

This study was designed to gain more insight into the relationships between knowledge of family health history (FHH), social determinants of health (SDoH) and the presence of medical conditions within a family. Family health history plays a vital role in the risk assessment for patients who receive genetic counseling. It can give practitioners insight into risk for not only Mendelian genetic conditions but also those of a multifactorial nature such as diabetes, heart disease, and more. Past research has shown that one's own knowledge of their FHH can impact one's own physical health (Feero et al., 2008). It is important to be cognizant of the possible factors that can impact a patient's knowledge of their FHH and to understand that patients come to clinic with varying FHH knowledge. Not only can a patient's knowledge impact risk assessment but it can also impact eligibility for genetic testing and recommendations for care. The results of this study are valuable in continuing conversation about the types of factors that are associated with FHH knowledge and how practitioners can adapt to establish the most equitable care.

4.1 Knowledge of Family Health History

4.1.1 Demographic and Descriptive Data

One of the important findings of this study is that there are significant differences seen in reported knowledge of FHH and collected demographic and descriptive data (Table 5). It was found that individuals who identified as Non-Hispanic White were more likely to have more knowledge of their FHH, while all other racial and ethnic minority groups were less likely to

have knowledge of their FHH. This finding could be for a variety of reasons, and it is important to note that there are many unique differences within an individual's life, their family, and familial communication style that could result in these findings. There could be a stigma surrounding the condition or diagnosis that needs to be shared, a fear of burdening others in the family with a difficult diagnosis, a predetermined culture of privacy within the family, or boundaries put in place that prevent individuals from sharing personal health information. Previous research has shown that those who identified as Chinese and Korean were less likely to share a diagnosis within the family compared to those that identified as American (Hong et al, 2017). This study supports past research and gives more insight into how differences in FHH knowledge extend throughout multiple race and ethnicities. Individuals who identified as a woman were more likely to report knowing more about their FHH. It is known that women are more communicative and desire connectedness compared to men (Lee et al., 2000). This finding makes sense considering that knowledge, more in depth conversations and having conversations more often leads to the sharing of more information. It has been found in past research that women (compared to men) are more likely to seek out social support when coping with difficult problems or bad news (Ptacek et al., 1992) which could explain a higher knowledge of their FHH. Lastly it was found that individuals older than 45 years old were more likely to report more knowledge of their FHH. A possible explanation for this result is that older individuals have more experience and time with the people in their family. There has been more time to hear stories about family members and possibly older generations have raised children, all of which would give individuals access to information about familial diagnoses. Previous research supports these findings; a recent study showed a significant difference in the level of FHH knowledge reported by individuals at different ages. The study concluded that participants older

than 50 were significantly more likely to report knowing more about their FHH compared to younger participants in the 18 to 25 year age group (Ashida et al., 2012). Overall, the findings discussed above have been found to be consistent with previously published literature which have found similar associations with race and ethnicity (Li et al., 2022 and Chavez-Yenter et al., 2022), gender identity (Chavez-Yenter et al., 2022), and age group (Ashida et al., 2012).

Many individuals still have gaps in knowledge that need to be addressed when it comes to familial diagnoses and the impact that has on their own physical health. A recent study showed that only 40% of males who had a sibling diagnosed with prostate cancer increased their preventative screening, while the remaining showed no change in preventative screening behaviors (Pruthi et al., 2006). Patient education is an extremely vital part of emphasizing how important knowledge of FHH is for an individual's health. Research has shown that individuals who reported more familiarity with genetics and have high perceived importance of genetic information are more likely to report knowing more about their FHH (Ashida et al., 2012). These findings are important for Genetic Counselors, and other practitioners, to keep in mind when eliciting FHH information from patients. Knowledge of FHH can vary based on demographic and descriptive factors showing that the family history that is collected may not be truly representative of the whole family.

4.2 Social Determinants of Health

4.2.1 Family Health History Knowledge

The study also examined the average Social Determinants of Health (SDoH) scores of participants who reported having 'A Lot', 'Some', or 'None at all' knowledge of their FHH

(Figure 4). SDoH data available through the All of Us study includes data on neighborhood, support, relationships, discrimination (in everyday life and in healthcare setting), food and housing security, perceived stress, and religion and spirituality. This study focused on analysis of SDoH scores corresponding to Support (support system), Relationships (relationships with others), Perceived Stress (an individual's perceived level of stress), and Religion and Spirituality (experiences with religion and spirituality). This study found a significant association between higher average SDoH scores and participants' reported knowledge of FHH, with those who reported more knowledge having higher SDoH scores within the Support, Relationships, and Perceived Stress categories. Particularly, participants with more support, closer relationships with those around them, and higher levels of perceived stress had higher levels of FHH knowledge. It is important to note that this finding cannot be categorized as a one-way cause and effect relationship. With individuals who had more support and closer relationships, this may have extended to their family members making it more likely for them to have higher knowledge of FHH. The same findings within the perceived stress category suggest that individuals who are less stressed are more likely to be aware of FHH information. Past research has shown that individuals who report less stress are more likely to have comfort in communicating with others (Kalish et al., 2015, Sangal et al., 2021 and Williams et al., 2021). It is also possible that this group has less stress because they have more strategies for coping with stress. One common coping strategy to lower stress levels is using knowledge to gain control over a problem or situation (Steptoe et al., 1991 and Khee et al., 2003). It is possible this group of individuals has learned to seek out knowledge to cope with difficult situations or worries and that has translated to a desire to collect their FHH.

It may be helpful for genetic counselors and other healthcare providers to be aware of the associations between knowledge of FHH and average SDoH scores. There is current encouragement within the medical community to collect a patient's SDoH in the electronic medical record (EMR) so all members of their healthcare team can access the information (Cantor et al., 2018). It is also possible for genetic counselors to adapt this approach in their own clinics by asking patients to fill out questionnaires about knowledge of FHH or their support system before their appointments. There is also the option of having a conversation with the patient about whether they have a support system set into place and how their family dynamics are a part of that support system. Often, genetic testing results can impact not only our patient but also their family members and it is important to help the patient work through how to have conversations with those family members about the implications of a result. If these practices were more widely implemented within the healthcare community, it could become another tool for genetic counselors to more deeply understand a patient's FHH knowledge and family dynamic coming into a counseling appointment.

An individual's knowledge of their FHH plays an important role in determining eligibility for genetic testing, clinical diagnoses, and offering carrier screening. For many conditions, eligibility for genetic testing can be determined through a list of guidelines that were created by various academic or national societies. An example of this is within the cancer genetic counseling field. The National Comprehensive Cancer Network (NCCN) provides guidelines for genetic counselors to determine when to recommend genetic testing for a patient. These guidelines take into account whether a patient has had a personal diagnosis (including age at diagnosis, pathology of cancer, ancestry, and type of cancer), familial diagnosis (type of cancer, age of diagnosis), and probability of diagnosis based on risk scoring models (Daly et al., 2024).

NCCN guidelines are extremely comprehensive, but patients who have a poor understanding of their cancer FHH and do not have a personal diagnosis of cancer are unlikely to meet criteria.

For some genetic conditions, a clinical diagnostic evaluation may be completed before undergoing genetic testing to determine if they have a molecular diagnosis as well. An example of a condition where this can occur is Neurofibromatosis 1 (NF1), a condition characterized by features that can include, café-au-lait macules, inguinal freckling, cutaneous neurofibromas, and learning disability/behavior problems. To obtain a clinical diagnosis of NF1 a patient must either meet specific phenotypic criteria that are associated with the condition or have a parent who meets the same criteria (Friedman et al., 2022). For those who show mild phenotypic criteria that is insufficient to make a clinical diagnosis it is important for those individuals to have knowledge about their family member's health. This means that a patient who does not know the details of their family health history may be less likely to receive a clinical diagnosis or qualify for genetic testing.

Another setting of genetic counseling where FHH knowledge is impactful to provider decision making is within the prenatal and preconception genetics realm. It is recommended by the American College of Medical Genetics and Genomics (ACMG) that individuals who are planning a pregnancy or are currently pregnant should be offered Tier 3 carrier screening. Tier 3 carrier screening includes all conditions that that have greater than a 1/200 carrier frequency and X linked conditions. For couples who meet certain criteria it is recommended to offer them more comprehensive carrier screening, known as Tier 4. Tier 4 includes conditions all conditions in Tier 3 as well as those that have a less than 1/200 carrier frequency. Tier 4 is offered in specific cases that include a pregnancy that arises from a consanguineous relationship (2nd cousins or closer in relation) and when a family or personal medical history warrants further testing. ACMG

acknowledges that not all genetic conditions are included on carrier screening panels, and it is important that family history is taken into consideration (Grody et al., 2013). This highlights the barriers that could exist when FHH is not well known for either individual in the couple. They may not know about a shared relative or may not be aware of a family history of a condition that could occur in their children. These factors should be taken into consideration when making decisions about carrier screening.

It is also important to acknowledge that patients seeking genetic testing or a diagnosis for a condition may be adopted and have no knowledge of their biological parents. The data gathered within this study did not include whether individuals who completed surveys were adopted. It is essential to be aware of this group of individuals and adapt guidelines and risk assessment to take into account a patient's gaps in FHH knowledge, both for adopted individuals, and also those who have less knowledge about FHH for other reasons.

It will be important to gain more understanding of the barriers that can keep people from knowing their FHH or collecting their FHH from their relatives. There are different approaches that can be introduced into a clinic to encourage patients to come to their appointment with as much information as possible about their FHH. Possible approaches include reaching out to patients prior to their visit or sending patients a questionnaire about their FHH to encourage the collection of diagnoses from their relatives. It may also be valuable to have a discussion with patients about the importance of communicating FHH within their family. This discussion could also be helpful for the genetic counselor to gauge how much knowledge the patient has of their FHH. Recognizing that certain patient populations tend to have less knowledge of their FHH can assist genetic counselors, and other healthcare workers, in implementing strategies to encourage patients to learn more about their FHH.

One of the other SDoH categories analyzed was Religion and Spirituality to determine whether individuals who had more experience with religious or spiritual practices were more likely to know more about their FHH. The findings were not found to follow the same pattern as discussed above, demonstrating a lack of association between religion and spirituality and knowledge of FHH.

4.2.2 Reported Medical Conditions

This study examined the associations between SDoH and three medical conditions: anxiety, depression, and hypertension (HTN). It is known that SDoH can shape one's health and health outcomes, and studies have shown that an individual's SDoH can account for 30% to 80% of one's physical health outcomes (Hood et al., 2016 and *Social Determinants of Health*, World Health Organization). In this study it was predicted that individuals who reported a personal medical condition would have lower average SDoH scores (for support, relationships, and religion and spirituality) when compared to those who reported no personal medical condition diagnosis. The opposite was predicted for the perceived stress category. This was examined by looking at the average SDoH scores of individuals who reported presence of a medical condition as occurring in themselves or their first-degree relatives (FHH), or not at all. The results showed that individuals with a personal diagnosis of anxiety or depression had lower SDoH scores, in all four categories, compared to those who did not have a personal diagnosis. For those with either diagnosis it is possible that this has impacted their relationships and level of support in their life, either because the diagnosis has forced that individual into self-isolation (Brown et al., 2021 and Wilkialis et al., 2021) or because a support system or strong relationships may not have existed in the first place. In addition, either diagnosis (anxiety or depression) could cause stress to an

individual and make it more difficult to work on managing that stress. Associations within the religion and spirituality category show that these individuals may not have as positive of an experience with religion and spirituality. It is possible that not wanting to get involved in a religious community could be due to self-isolation or feeling like religion and spirituality will not help with the symptoms they are experiencing with their diagnosis. However, it is important to note that there are factors other than the diagnosis of anxiety or depression that can influence the average SDoH score and therefore this relationship cannot be defined as one-way cause and effect.

Other studies have shown that SDoH can impact one's health outcomes, and many of these studies focus on SDoH categories such as income, neighborhood, or food insecurity. Fewer studies have focused on the SDoH (support, relationships, perceived stress, and religion and spirituality). Past research found that a low level of social support or no social support was a predictor of anxiety/depression or anxiety/depression related symptoms (Johnson et al., 2022 and Paykel et al., 1994). Research has also shown that having social networks and/or supportive relationships significantly reduces the odds of anxiety and/or depression symptoms after experiencing a difficult life event (Paykel et al., 1994). There has also been a multitude of research conducted that show higher levels of stress is a risk factor for an individual to develop anxiety or depression (McLaughlin et al., 2009, Robinson et al., 1990, Ross et al., 2017, and Tafet et al., 2016). These results align with the findings of this study that show SDoH scores reflecting higher stress for those who reported personal anxiety or depression. There have been a few studies conducted on the association of religion and spirituality with levels of anxiety and/or depression. Studies have shown that a positive experience with religion and/or spirituality is associated with lower levels of anxiety and depression (Rosmarin et al., 2020 and Fruehwirth et

al., 2019). It is also possible that one's experience with religion and spirituality interacts with the SDoH that reflect relationships and support, as belonging to a certain religion or practice can come with a built-in community and/or support system.

The results for HTN did not follow the same pattern as found with anxiety and depression. A finding that should be highlighted is that individuals with a personal diagnosis of HTN had higher SDoH scores within the perceived stress category (reflecting less stress), compared to those who did not have a personal diagnosis of HTN. This finding is inverse compared to what was found with the other medical conditions looked at. A possible explanation for this is that individuals with HTN have learned to cope with stress to help with the management of their HTN diagnosis. It has been found within literature that higher levels of stress can be associated with a higher risk for HTN or other cardiovascular diseases (Cohen et al., 2015). Recommendations from American Family Physician in treating HTN include talking with patients about stress reduction techniques such as meditation, relaxation, mindfulness, and breathing practices (Unger et al., 2020). Multiple studies have been done to support the positive impact that these techniques can have on lowering blood pressure (García-Vera et al., 2004). Lower reported stress in patients with a HTN diagnosis could be due to a variety of factors but one in particular is that patients are aware of their stress and are implementing techniques to focus on lowering it.

Additional analyses were completed to evaluate the three-way relationships between SDoH scores, Reported Medical Conditions, and FHH Knowledge. This analysis shows the same patterns that are summarized above; the relationships between SDoH and FHH knowledge remained similar, regardless of the medical conditions present in the personal and family history.

These findings indicate that the relationship between SDoH scores and knowledge of FHH may be generalizable in various settings.

4.3 Limitations

While this study identified significant relationships between knowledge of family health history, demographic factors, social determinants of health, and personal/familial diagnoses of specific medical conditions, it is important to acknowledge that there are also limitations to be considered. The data in this study is self-reported by the participants of the All of Us Research Program. There is no method for the researchers of this study to confirm the accuracy of reported personal and familial diagnoses, or the participant's reported level of FHH knowledge. In addition, this study used a broad grouping of individuals by race and ethnicity, but there remain many subgroups within these ethnicities and races, and the findings almost certainly cannot be generalized to all of these subgroups.

4.4 Future Directions

Further investigation of the relationships that were uncovered in this study could include a multivariate analysis to estimate the individual effects of each factor, while taking into account the others, to investigate possible interactions. There is further research indicated in order to fill gaps in knowledge and understand the intricacies of familial communication of FHH. In expanding the study, it would be beneficial to include more SDoH categories, such as income, neighborhood, or experience receiving medical care. Expanding the study to look at these SDoH will broaden the research and help researchers gain more understanding in the associations these SDoH may have with an individual's knowledge of FHH. There was an option within the FHH

survey for an individual to report whether they have received treatment for their condition. A possible future direction would be to look into individuals who have undergone treatment compared with those who have not to determine whether there is a relationshipthe SDoH scores. In addition, it is important for the research to expand to include other medical conditions, such as diabetes, heart disease, or various types of cancers. There has been current research conducted looking at the associations between mental health conditions and cardiovascular disease (CVD) (Cohen et al., 2015). One possible area of further study would be to look at the SDoH scores in those who reported anxiety and/or depression and also have CVD. Furthermore, it is especially important to examine the group of individuals who reported knowing nothing at all about their FHH. It is imperative we understand more about the potential barriers this group of people face so healthcare practitioners can implement solutions to support the growth of FHH knowledge.

4.5 Conclusion

Higher knowledge of family health history (FHH) is more likely to be reported in those who identify as Non-Hispanic White, identify as a woman, and identify as older than 45. This finding suggests that there is a possibility that the entire health history of the family is not being gathered fully because of various factors that impact an individual's knowledge of their FHH. A possible reason for this result is differences in familial communication styles between individuals of different races, ethnicities and genders, as well as stigma surrounding a condition which could make it more difficult to communicate. Individuals who are older would have had more time to gather their FHH, making it more likely for them to know more about their FHH than younger generations. Higher average social determinants of health (SDoH) scores were found to be associated with higher levels of FHH knowledge. This finding suggests that more support,

higher quality relationships, and lower levels of perceived stress influence an individual's knowledge of their FHH. Individuals with more support and higher quality relationships could feel more comfortable opening up about difficult diagnoses or leaning into tough health related conversations with family members. In addition, those who have lower perceived stress could be better at communicating and therefore be more likely to collect their FHH . It is important to have the full picture of a family health history when determining a differential diagnosis, the type of carrier screening to order, or a patient's eligibility for genetic testing.

This study highlights the need for patient education about the importance of gathering FHH as well as demonstrates that patients will come into clinic with a wide variety of FHH knowledge. Understanding each of these aspects provides practitioners the opportunity to conduct an educated risk assessment and improve personalized patient care.

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6. APPENDIX

6.1 Appendix I – Family Health History Survey Questions

How much do you know about illnesses or health problems for your parents, grandparents, brothers, sisters, and/or children?

- A lot
- Some
- None at all

Including yourself, who in your family has had anxiety reaction/panic disorder? Select all that apply.

- Self
- Mother
- Father
- Sibling
- Daughter
- Son
- Grandparent

Including yourself, who in your family has had depression? Select all that apply.

- Self
- Mother
- Father
- Sibling
- Daughter
- Son
- Grandparent

Including yourself, who in your family has had high blood pressure (hypertension)? Select all that apply.

- Self
- Mother
- Father
- Sibling
- Daughter
- Son
- Grandparent

6.2 Appendix II – Social Determinant of Health Survey Questions

Support

Supportive relationships may play a key role in helping people live healthy lives. Answering the following questions may help researchers learn more about the potential health benefits of supportive relationships.

People sometimes look to others for friendship, help, or other types of support. Choose the answer that best describes how often you can find support if you need it? (Sherbourne et al., 1991).

1. **Someone to help you if you were confined to bed**
    - None of the time
    - A little of the time
    - Some of the time
    - Most of the time
    - All of the time
2. **Someone to take you to the doctor if you need it**
    - None of the time
    - A little of the time
    - Some of the time
    - Most of the time
    - All of the time
3. **Someone to prepare your meals if you were unable to do it yourself**
    - None of the time
    - A little of the time
    - Some of the time
    - Most of the time
    - All of the time
4. **Someone to help with daily chores if you were sick**
    - None of the time
    - A little of the time
    - Some of the time
    - Most of the time
    - All of the time
5. **Someone to have a good time with**
    - None of the time
    - A little of the time
    - Some of the time
    - Most of the time
    - All of the time
6. **Someone to turn to for suggestions about how to deal with a personal problem**

- None of the time
- A little of the time
- Some of the time
- Most of the time
- All of the time

7. **Someone who understands your problems**
    - None of the time
    - A little of the time
    - Some of the time
    - Most of the time
    - All of the time
8. **Someone to love and make you feel wanted**
    - None of the time
    - A little of the time
    - Some of the time
    - Most of the time
    - All of the time

Relationships

We would like to ask you some questions about your relationships with others. Choose the answer that is true for you (Sherbourne et al., 1991).

1. **I lack companionship**
    - Never
    - Rarely
    - Sometimes
    - Often
2. **There is no one I can turn to**
    - Never
    - Rarely
    - Sometimes
    - Often
3. **I am an outgoing person**
    - Never
    - Rarely
    - Sometimes
    - Often
4. **I feel left out**
    - Never
    - Rarely

- Sometimes
- Often

5. **I feel isolated from others**
    - Never
    - Rarely
    - Sometimes
    - Often
6. **I can find companionship when I want it**
    - Never
    - Rarely
    - Sometimes
    - Often
7. **I am unhappy being so withdrawn**
    - Never
    - Rarely
    - Sometimes
    - Often
8. **People are around me but not with me**
    - Never
    - Rarely
    - Sometimes
    - Often

Perceived Stress

The amount of stress you feel can lead to negative health outcomes. Sharing your experiences may help researchers identify common triggers that induce stress in individuals and ways to provide support for individuals and communities.

The next questions ask you about your feelings and thoughts during the last month. Please choose how often you felt or thought a certain way. (Cohen et al., 1983)

1. **In the last month, how often have you been upset because of something that happened unexpectedly?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often
2. **In the last month, how often have you felt that you were unable to control the important things in your life?**
    - Never

- Almost Never
- Sometimes
- Fairly Often
- Very Often

3. **In the last month, how often have you felt nervous and "stressed"?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often
4. **In the last month, how often have you felt confident about your ability to handle your personal problems?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often
5. **In the last month, how often have you felt that things were going your way?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often
6. **In the last month, how often have you found that you could not cope with all the things that you had to do?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often
7. **In the last month, have you often have you been able to control irritations in your life?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often
8. **In the last month, how often have you felt that you were on top of things?**
    - Never
    - Almost Never
    - Sometimes

- Fairly Often
- Very Often

9. **In the last month, how often have you been angered because of things that were outside of your control?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often
10. **In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?**
    - Never
    - Almost Never
    - Sometimes
    - Fairly Often
    - Very Often

Religion and Spirituality

Elements of religion and spirituality can affect health outcomes. Sharing your beliefs and experiences may help researchers better understand the effects of religion and spirituality on health and well-being.

The next questions ask about your spiritual life. Some questions use the word "God." If it makes you more comfortable, you can replace that word with whatever you believe is spiritual, holy, or divine when answering (M*ultidimensional Measurement of Religiousness/Spirituality*, Fetzer Institute).

How often do you experience the following:

1. **I feel God's (or a higher power's presence**
    - Many times a day
    - Every day
    - Most days
    - Some days
    - Once in a while
    - Never or almost never
    - I do not believe in God (or a higher power)
2. **I find strength and comfort in my religion**
    - Many times a day
    - Every day
    - Most days

- Some days
- Once in a while
- Never or almost never
- I am not religious

3. **I feel deep inner peace or harmony**
    - Many times a day
    - Every day
    - Most days
    - Some days
    - Once in a while
    - Never or almost never
4. **I desire to be closer to or in union with God (or a higher power)**
    - Many times a day
    - Every day
    - Most days
    - Some days
    - Once in a while
    - Never or almost never
    - I do not believe in God (or a higher power)
5. **I feel God's (or a higher power's) love for me, directly or through others**
    - Many times a day
    - Every day
    - Most days
    - Some days
    - Once in a while
    - Never or almost never
    - I do not believe in God (or a higher power)
6. **I am spiritually touched by the beauty of creation**
    - Many times a day
    - Every day
    - Most days
    - Some days
    - Once in a while
    - Never or almost never
7. **How often do you go to religious meetings or services?**
    - More than once a week
    - Once a week
    - 1 to 3 times per month
    - Less than once per month
    - Never (or almost never)
    - I am not religious

6.3 APPENDIX III – Exploration of the Multivariate Relationship Between Social Determinant of Health, Knowledge of Family Health History, Presence of Anxiety, Depression, or Hypertension

6.3.1 Sample Size for Social Determinant of Health Survey Participants who also Participated in the Family Health History Survey

The following data covers the exploration of the three-way relationship between SDoH, knowledge of FHH, and personal and/or familial presence, or absence, or anxiety, depression, and hypertension. Table 11, 12, and 13 gives an overview of the sample size for the three conditions that will be looked at; anxiety, depression, and hypertension, respectively.

Table 11. Sample size of Average Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety (includes support, relationships, perceived stress, and religion/spirituality SDoH categories)

		Reported Knowledge of FHH		
		A Lot	**Some**	**None at all**
Reported Anxiety	**Only Personal**	33.7% (n=3,632)	62.2% (n=6,701)	4.0% (n=435)
	Personal and FDR	41.4% (n=4,971)	57.8% (n=6,928)	0.8% (n=96)
	Only FDR	44.9% (n=5,112)	54.9% (n=6,243)	0.2% (n=24)
	None Reported/Skipped	35.7% (n=24,714)	61.3% (n=42,400)	3.0% (n=2,087)

Table 12. Sample size of Average Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression (includes support, relationships, perceived stress, and religion/spirituality SDoH categories)

		Reported Knowledge of FHH		
		A Lot	**Some**	**None at all**
Reported Depression	**Only Personal**	33.6% (n=4,329)	61.7% (n=7,934)	4.7% (n=602)
	Personal and FDR	40.6% (n=7,803)	58.7% (n=11,283)	0.7% (n=129)
	Only FDR	42.7% (n=6,461)	57.0% (n=8,632)	0.3% (n=44)
	None Reported/Skipped	35.3% (n=19,836)	61.3% (n=34,423)	3.3% (n=1,867)

Table 13. Sample size of Average Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension (includes support, relationships, perceived stress, and religion/spirituality SDoH categories)

		Reported Knowledge of FHH		
		A Lot	**Some**	**None at all**
Reported Hypertension	**Only Personal**	30.6% (n=3,089)	63.6% (n=6,416)	5.7% (n=578)
	Personal and FDR	41.5% (n=9,569)	58.0% (n=13,360)	0.5% (n=110)
	Only FDR	42.0% (n=13,710)	57.6% (n=18,795)	0.4% (n=139)
	None Reported/Skipped	32.1% (n=12,061)	63.1% (n=23,701)	4.8% (n=1,815)

6.3.2 Social Determinant of Health – Support

Table 14 displays the Support average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of anxiety. ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10765)=399$, $p<0.00001$), Personal and FDR ($F(2,11992)=405$, $p<0.00001$), Only FDR ($F(2,11376)=234$, $p<0.00001$), and None Reported/Skipped ($F(2,69198)=2332$, $p<0.00001$). When looking at Figure 6a, the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. Post-hoc tests were run and found significance ($p<0.0001$) in the Only Personal, Personal and FDR, and None Reported/Skipped categories. Significance was found in the Only FDR category between A Lot & Some and A Lot & None at all ($p<0.0001$), but significance was not found between Some & None at all ($p<0.25$). Figure 6b compares the average SDoH scores between presence of personal and/or familial anxiety, or lack of anxiety reported. In all three levels of FHH knowledge, reported personal anxiety had lower average SDoH scores compared to those who reported no personal anxiety. This finding was found to be significant in the A lot and Some categories ($p<0.039$) but not in the None at all category ($p<0.67$). In the A Lot and Some categories Only Personal anxiety reported represented the lowest SDoH score out of the four possible categories ($p<0.021$) while Only FDR Anxiety represented the highest average score ($p<0.039$). ANOVA was run and determined significance in all three FHH Knowledge; A Lot ($F(3,38429)=373$, $p<0.00001$), Some ($F(3,62268)=909$, $p<0.00001$), and None at all ($F(3,2638)=11.6$, $p<0.00001$). Additional post-hoc tests were run and found significance between all values in the A Lot and Some reported categories ($p<0.039$). In the None at all category, only

significance between Only Personal Anxiety and None Reported/Skipped ($p<0.011$) was established.

Table 14. Average Support Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety and No Reported Anxiety

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Anxiety	Only Personal	3.86 ± 1.23	3.64 ± 1.29	3.37 ± 1.44
	Personal and FDR	3.93 ± 1.20	3.70 ± 1.25	3.43 ± 1.35
	Only FDR	4.08 ± 1.10	3.93 ± 1.14	3.53 ± 1.52
	None Reported/Skipped	4.05 ± 1.14	3.88 ± 1.20	3.52 ± 1.41

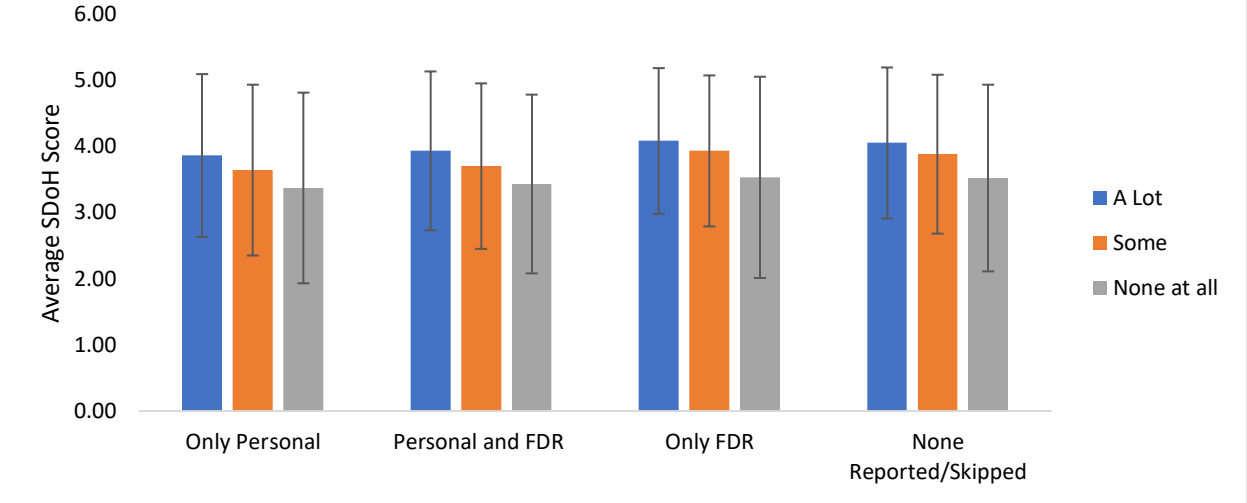

Figure 6a

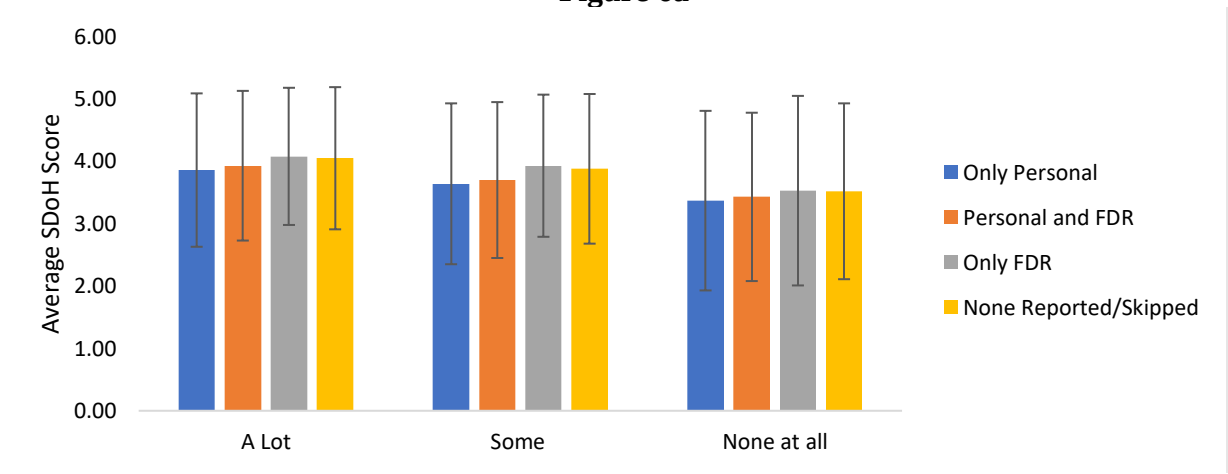

Figure 6b

Average Support Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Anxiety, Personal and FDR Anxiety, Only FDR Anxiety, or no Personal and/or FDR Anxiety/Skipped the question altogether, sample size values in Table 11. Average SDoH of each group was taken and segregated based on SDoH questions answered in support category, responses scored 1-5.

Table 15 displays the Support average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of depression. ANOVA was run and significance was found in all four categories; Only Personal ($F(2,12862)=549$, $p<0.00001$), Personal and FDR ($F(2,19212)=674$, $p<0.00001$), Only FDR ($F(2,8673)=299$, $p<0.00001$), and None Reported/Skipped ($F(2,56123)=1884$, $p<0.00001$). When looking at Figure 7a, the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. Post-hoc tests were run and found significance ($p<0.0001$) in the Only Personal, Personal and FDR, and None Reported/Skipped categories. Significance was found in the Only FDR category between A Lot & Some and A Lot & None at all ($p<0.0001$), but significance was not found between Some & None at all ($p<0.21$). Figure 7b compares the average SDoH scores between presence of personal and/or familial depression, or lack of depression reported. In all three levels of FHH knowledge categories reported personal depression had lower average SDoH scores compared to those who reported no personal depression. This finding was found to be significant in the A lot and Some categories ($p<0.025$) but not in the None at all category ($p<0.7$). In the A lot and Some categories, Only Personal Depression reported represented the lowest SDoH score ($p<0.024$) while Only FDR Depression always represented the highest average SDoH score ($p<0.023$). ANOVA was run and determined significance in all three FHH Knowledge categories; A lot ($F(3,27635)=1016$, $p<0.00001$), Some ($F(3,54334)=2200$, $p<0.00001$), and None at all ($F(3,2638)=69.7$, $p<0.00001$). Additional post-hoc tests were run and found significance ($p<0.0001$) between all values in the A Lot and Some reported categories.

In the None at all category, significance was found between all categories except Only Personal & Personal & FDR ($p<0.7$) and Only FDR & None Reported ($p<0.3$).

Table 15. Average Support Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression and No Reported Depression

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Depression	Only Personal	3.82 ± 1.24	3.60 ± 1.30	3.27 ± 1.44
	Personal and FDR	3.87 ± 1.20	3.65 ± 1.26	3.26 ± 1.46
	Only FDR	4.13 ± 1.09	3.97 ± 1.13	3.69 ± 1.41
	None Reported/Skipped	4.09 ± 1.12	3.92 ± 1.18	3.58 ± 1.39

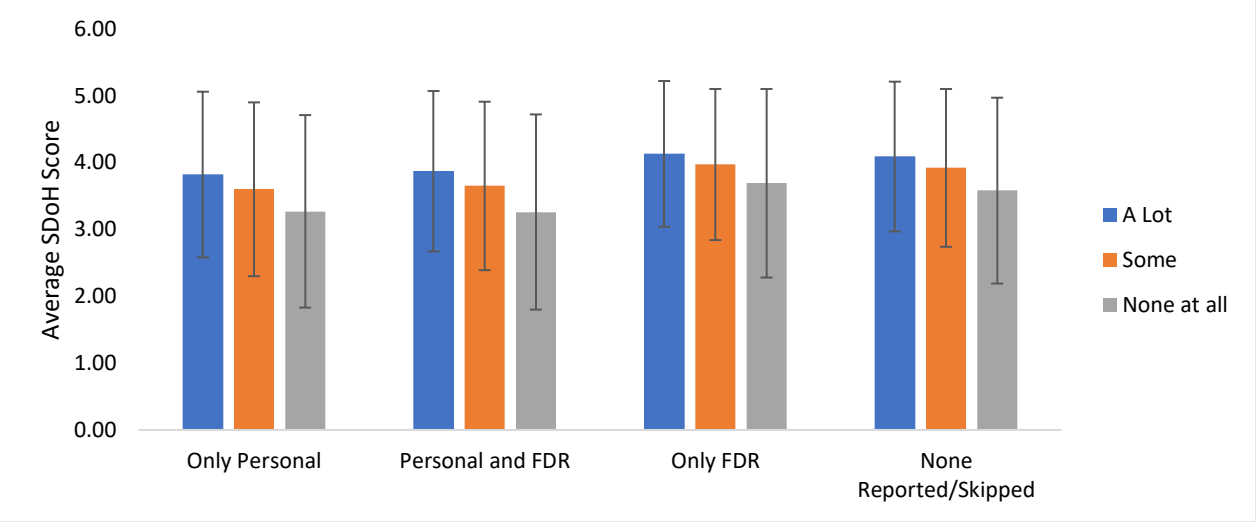

Figure 7a

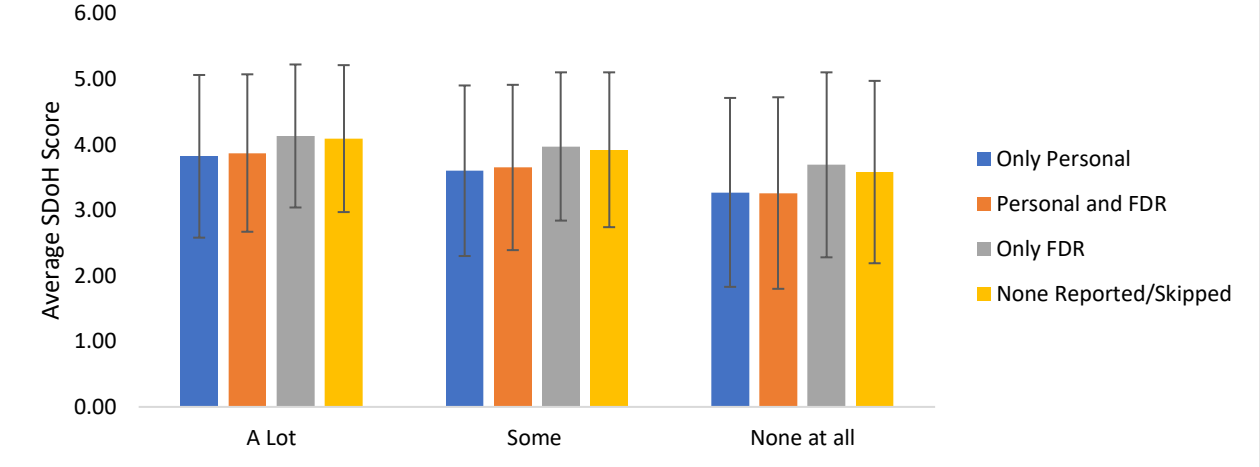

Figure 7b

Average Support Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Depression, Personal and FDR Depression, Only FDR Depression, or no Personal and/or FDR Depression/Skipped the question altogether, sample size values in Table 12. Average SDoH of each group was taken and segregated based on SDoH questions answered in support category, responses scored 1-5.

Table 16 displays the Support average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of hypertension. ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10080)=295$, $p<0.00001$), Personal and FDR ($F(2,23036)=521$, $p<0.00001$), Only FDR ($F(2,32641)=931$, $p<0.00001$), and None Reported/Skipped ($F(2,37574)=1531$, $p<0.00001$). When looking at Figure 8a, the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. Post-hoc tests were run and found significance ($p<0.0001$) between all categories. Figure 8b compares the average SDoH scores between presence of personal and/or familial hypertension, or lack of presence of hypertension. In all three levels of FHH knowledge, Only Personal and Personal & FDR always had lower average SDoH scores when compared to those who reported no personal hypertension. This finding was found to be significant in the A lot and Some categories ($p<0.021$) but not in the None at all category ($p<0.55$). In the A lot and Some categories, Only Personal Hypertension reported represented the lowest SDoH score ($p<0.015$) while Only FDR Hypertension always represented the highest average SDoH score ($p<0.021$). ANOVA was run and determined significance in the A Lot ($F(3,38425)=381$, $p<0.00001$) and Some ($F(3,62268)=489$, $p<0.00001$) FHH Knowledge categories, but not the None at all ($F(3,2638)=6.7$, $p<0.00001$) category. Post-hoc analysis was run and determined significance ($p<0.0001$) between all categories in A Lot and Some. Within the None at all category, significance was only found between Only Personal & None Reported/Skipped ($p<0.025$), all other categories were not found to be statistically significant.

Table 16. Average Support Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension and No Reported Hypertension.

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Hypertension	Only Personal	3.87 ± 1.24	3.70 ± 1.27	3.41 ± 1.45
	Personal and FDR	3.95 ± 1.19	3.76 ± 1.25	3.51 ± 1.42
	Only FDR	4.09 ± 1.11	3.90 ± 1.18	3.55 ± 1.39
	None Reported/Skipped	4.05 ± 1.15	3.87 ± 1.21	3.52 ± 1.40

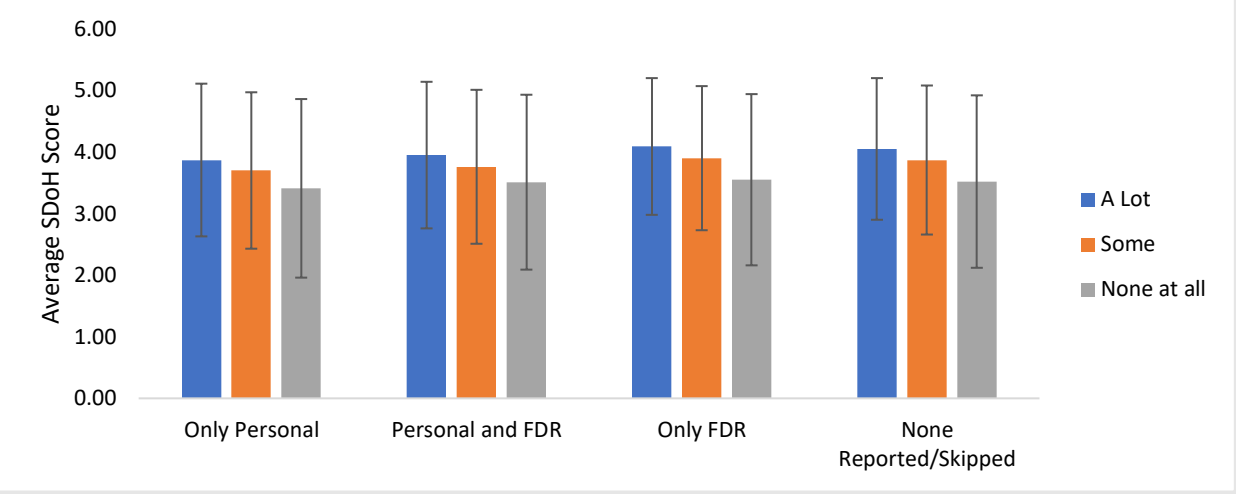

Figure 8a

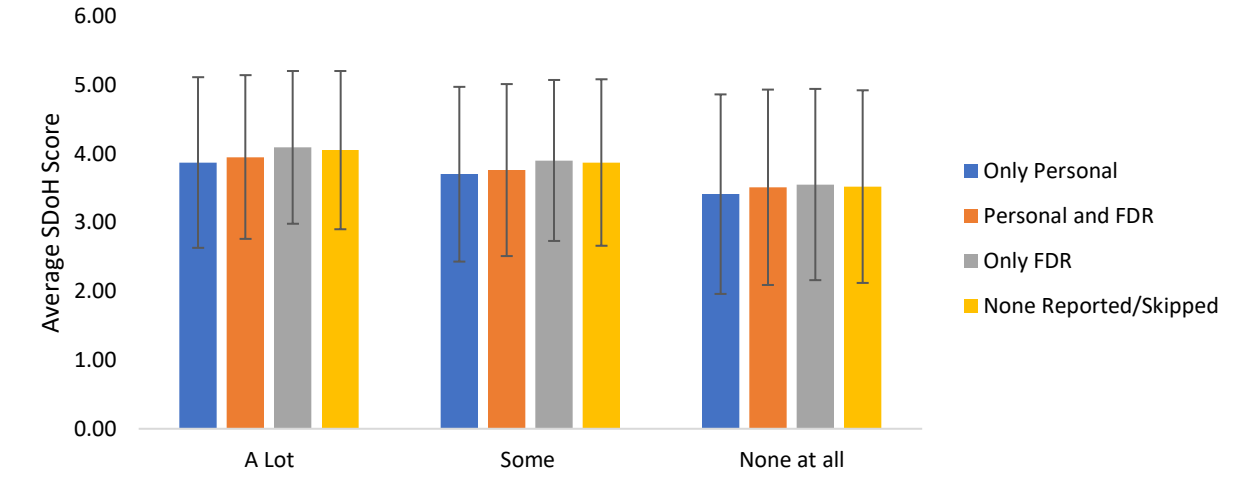

Figure 8b

Average Support Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Hypertension, Personal and FDR Hypertension, Only FDR Hypertension, or no Personal and/or FDR Hypertension/Skipped the question altogether, sample size values in Table 13. Average SDoH of each group was taken and segregated based on SDoH questions answered in support category, responses scored 1-5.

6.3.3 Social Determinant of Health – Relationships

Table 17 displays the Relationships average SDoH scores for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of anxiety. ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10765)=380$, $p<0.00001$), Personal and FDR ($F(2,11992)=316$, $p<0.00001$), Only FDR ($F(2,11376)=255$, $p<0.00001$), and None Reported/Skipped ($F(2,69198)=1662$, $p<0.00001$). In Figure 9a the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. Additional post-hoc tests were run and significance ($p<0.0001$) was found within Only Personal, Personal & FDR, and None Reported/Skipped categories. Within the Only FDR category significance was found between A Lot & Some ($p<0.0001$), while significance was not found between A Lot & None at all ($p<0.08$) and Some & None at all ($p<0.27$). Figure 9b compares the average SDoH scores between presence of personal and/or familial anxiety, or lack or presence. In all three levels of FHH knowledge, those that reported personal anxiety had lower average SDoH scores when compared to those who reported no personal anxiety. This was found to be significant in the A Lot ($p<0.034$), Some ($p<0.0001$), and None at all ($p<0.03$) categories. Personal and FDR anxiety reported represented the lowest SDoH score while None Reported/Skipped always represented the highest average SDoH score, this was only found to be significant in the A Lot category ($p<0.034$). ANOVA was run and determined significance in all categories, A Lot ($F(3,38429)=2768$, $p<0.00001$), Some ($F(3,62268)=5119$, $p<0.00001$), and None at all ($F(3,2638)=160$, $p<0.00001$). Post-hoc tests were run and determined significance ($p<0.0001$) between all reported/none reported anxiety for the A Lot category. In the Some category,

significance ($p<0.0001$) was present between all types of reported/none reported anxiety except between Only Personal and Personal & FDR ($p<0.139$). In the None at all category significance was present ($p<0.02$) between all types of reported/none reported anxiety except between Only Personal and Personal & FDR ($p<0.13$) and Only FDR & None Reported/Skipped ($p<0.39$).

Table 17. Average Relationships Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety and No Reported Anxiety

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Anxiety	Only Personal	1.91 ± 0.97	1.73 ± 0.98	1.62 ± 1.07
	Personal and FDR	1.87 ± 0.97	1.72 ± 0.97	1.52 ± 1.07
	Only FDR	2.18 ± 0.87	2.05 ± 0.90	1.93 ± 1.06
	None Reported/Skipped	2.25 ± 0.86	2.12 ± 0.89	1.99 ± 1.01

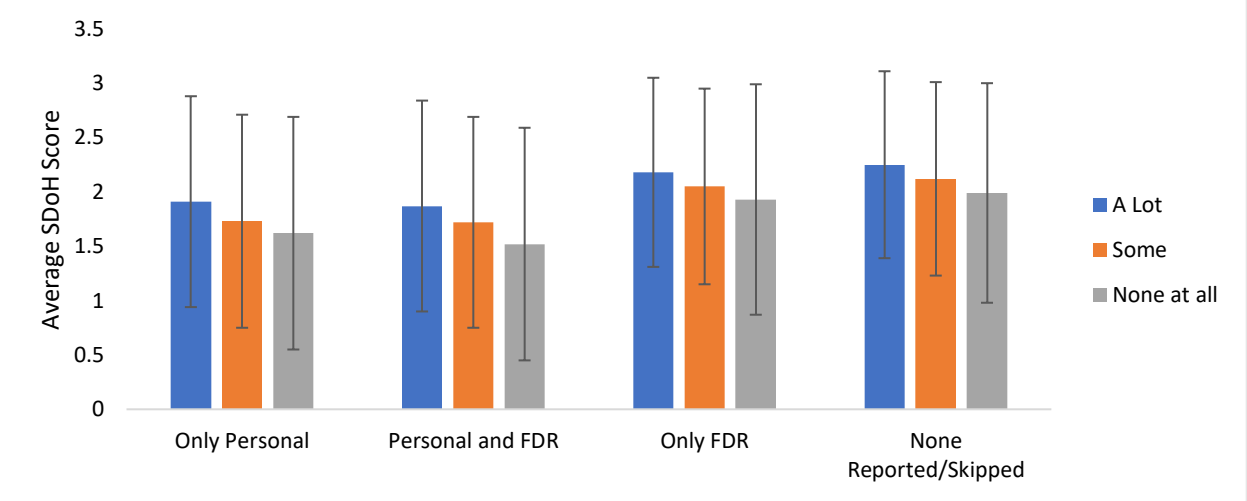

Figure 9a

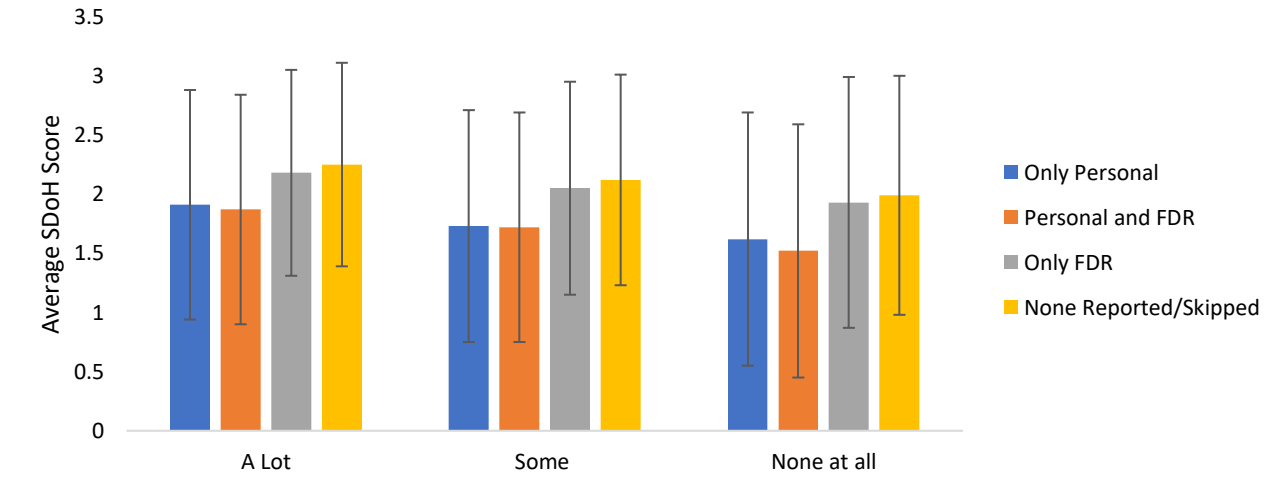

Figure 9b

Average Relationships Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Anxiety, Personal and FDR Anxiety, Only FDR Anxiety, or no Personal and/or FDR Anxiety/Skipped the question altogether, sample size values in Table 11. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-3.

Table 18 displays the Relationships average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of depression. When looking at Figure 10a, the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge ($p<0.02$). This pattern occurred in all reported depression categories except Only FDR, where the Some FHH Knowledge reported was lower than None at all reported ($p<0.39$). ANOVA was run and significance was found in all four categories; Only Personal ($F(2,12862)=447$, $p<0.00001$), Personal and FDR ($F(2,19212)=584$, $p<0.00001$), Only FDR ($F(2,8673)=298$, $p<0.00001$), and None Reported/Skipped ($F(2,56123)=1467$, $p<0.00001$). Post-hoc tests were run and significance was found within Only Personal ($p<0.012$), Personal & FDR ($p<0.02$), and None Reported/Skipped ($p<0.0001$) categories. Within the Only FDR category significance ($p<0.0001$) was found between A Lot & Some, while significance was not found between A Lot & None at all ($p<0.37$) and Some & None at all ($p<0.39$). Figure 10b compares the average SDoH scores between presence of personal and/or familial depression, or lack or presence. In all three levels of FHH knowledge, reporting of personal depression had lower average SDoH scores when compared to those who reported no presence of personal depression ($p<0.002$). In the A Lot and Some categories Personal and FDR Depression represented the lowest SDoH score while None Reported/Skipped always represented the highest average SDoH score ($p<0.002$). In the None at all category where Only FDR had the highest score ($p<0.08$), but this was not found to be significant. ANOVA was run and determined significance in all categories, A lot ($F(3,27635)=4939$, $p<0.00001$), Some ($F(3,54334)=9002$, $p<0.00001$), and None at all ($F(3,2638)=302$, $p<0.00001$). Post-hoc tests were run and determined significance

($p<0.0001$) between all reported/none reported depression for the A Lot and Some categories. Significance ($p<0.03$) was found in the None at all category between all types of reported/none reported depression except between Only FDR & None Reported/Skipped ($p<0.08$).

Table 18. Average Relationships Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression and No Depression Reported

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Depression	Only Personal	1.91 ± 0.96	1.74 ± 0.97	1.60 ± 1.05
	Personal and FDR	1.86 ± 0.97	1.69 ± 0.97	1.45 ± 1.09
	Only FDR	2.23 ± 0.85	2.11 ± 0.87	2.17 ± 0.90
	None Reported/Skipped	2.31 ± 0.84	2.18 ± 0.87	2.04 ± 0.99

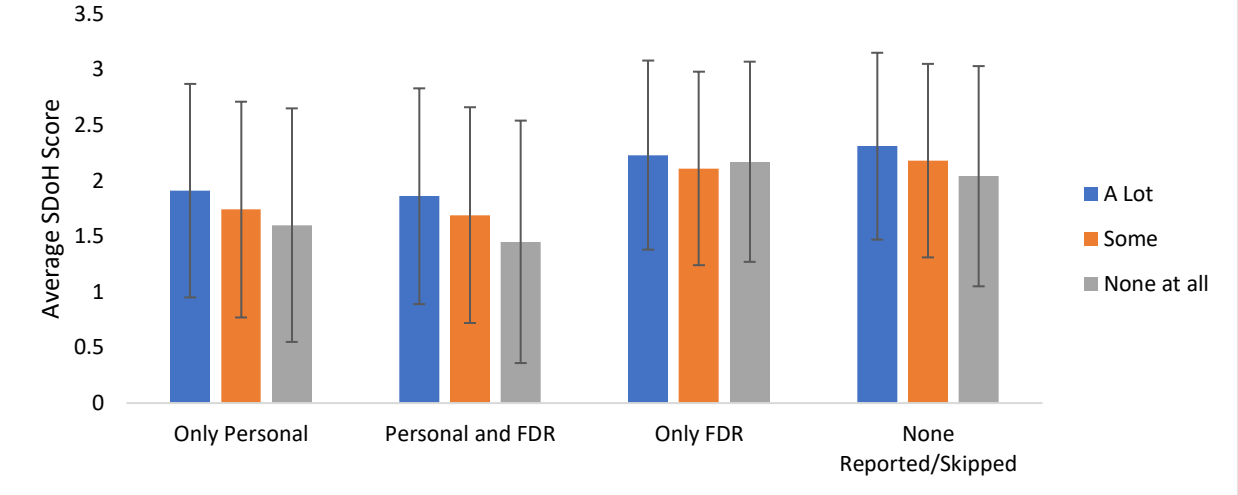

Figure 10a

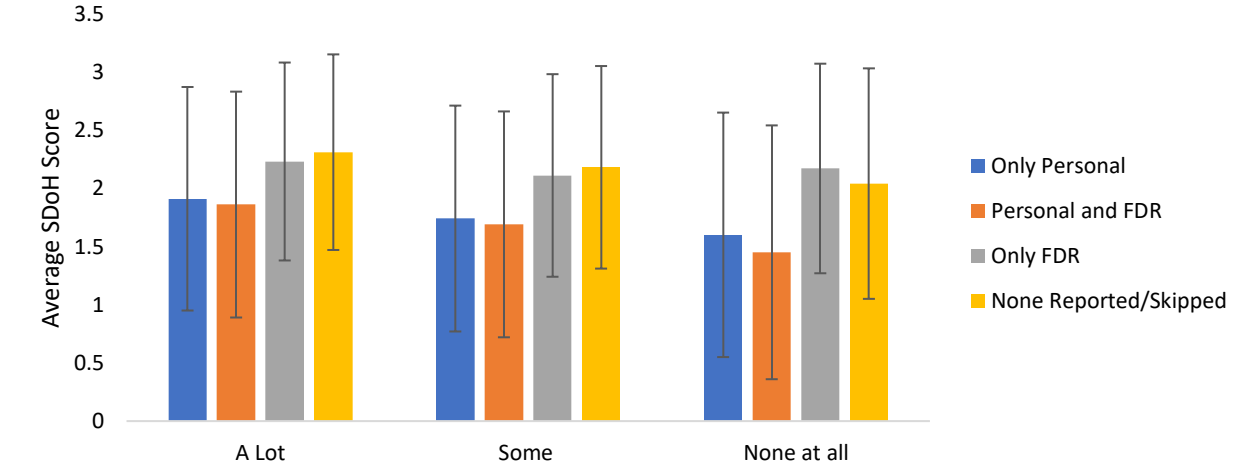

Figure 10b

Average Relationships Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Depression, Personal and FDR Depression, Only FDR Depression, or no Personal and/or FDR Depression/Skipped the question altogether, sample size values in Table 12. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-3.

Table 19 displays the Relationships average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of hypertension. When looking at Figure 11a, the average SDoH scores were higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10080)=242$, $p<0.00001$), Personal and FDR ($F(2,23036)=412$, $p<0.00001$), Only FDR ($F(2,32641)=752$, $p<0.00001$), and None Reported/Skipped ($F(2,37574)=1117$, $p<0.00001$). Additional post-hoc tests were run and significance was found within Only Personal and None Reported/Skipped categories ($p<0.0001$). Within the Personal and FDR hypertension category significance was found between A Lot & Some ($p<0.0001$) and A Lot & None at all ($p<0.019$), while significance was not found between Some & None at all ($p<0.066$). Within the Only FDR category significance was found between A Lot & Some ($p<0.0001$) and A Lot & None at all ($p<0.017$), while significance was not found between Some & None at all ($p<0.085$). Figure 11b compares the average SDoH scores between presence of personal and/or familial hypertension, or lack or presence, in all three levels of FHH knowledge, no obvious pattern was seen between the scores. The None Reported/Skipped category contained the highest scores compared to the other three categories, this finding was found to be significant in the A Lot ($p<0.015$) category but not in the Some ($p<0.8$) and the None at all ($p<0.65$) categories. ANOVA was run and determined significance in the A Lot ($F(3,38425)=21191$, $p<0.00001$) and Some ($F(3,62268)=68.6$, $p<0.00001$) FHH Knowledge categories, but not the None at all ($F(3,2638)=3.1$, $p<0.00001$) category. Post-hoc tests were run for each of the three categories. In the A Lot category significance was found between all types of reported/none reported

hypertension ($p<0.0001$) except Only Personal and Only FDR ($p<0.068$). In the Some category significance ($p<0.0001$) was found between all types of reported/none reported hypertension except between Only Personal & None Reported/Skipped and Personal and FDR & Only FDR ($p<0.8$). In the None at all category, no additional significance was found between any type of reported/none reported hypertension.

Table 19. Average Relationships Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension and No Reported Hypertension

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Hypertension	Only Personal	2.16 ± 0.91	2.04 ± 0.94	1.87 ± 1.05
	Personal and FDR	2.13 ± 0.92	2.01 ± 0.95	1.87 ± 1.07
	Only FDR	2.15 ± 0.89	2.01 ± 0.92	1.91 ± 1.02
	None Reported/Skipped	2.20 ± 0.89	2.04 ± 0.92	1.92 ± 1.02

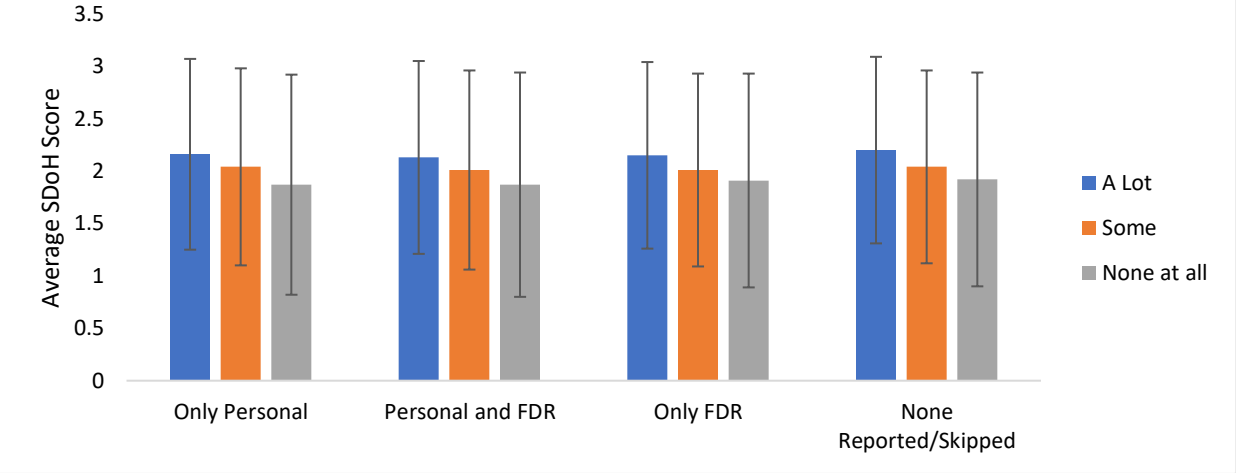

Figure 11a

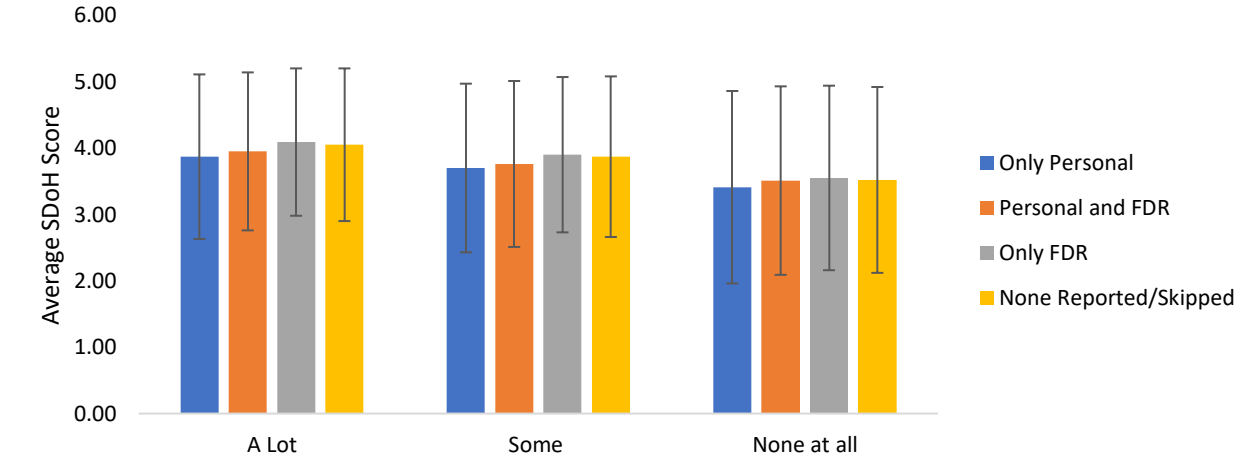

Figure 11b

Average Relationships Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Hypertension, Personal and FDR Hypertension, Only FDR Hypertension, or no Personal and/or FDR Hypertension/Skipped the question altogether, sample size values in Table 13. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-3.

6.3.4 Social Determinant of Health – Perceived Stress

Table 20 displays the Perceived Stress average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of anxiety. When looking at Figure 12a, the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10765)=2431$, $p<0.00001$), Personal and FDR ($F(2,11992)=369$, $p<0.00001$), Only FDR ($F(2,11376)=15630$, $p<0.00001$), and None Reported/Skipped ($F(2,69198)=132240$, $p<0.00001$). Additional post-hoc tests were run and significance was found within all four categories ($p<0.0001$). Figure 12b compares the average SDoH scores between presence of personal and/or familial anxiety, or lack or presence. In all three levels of FHH knowledge, reported personal anxiety had lower average SDoH scores when compared to those who reported no personal anxiety. This was found to be significant in the A Lot ($p<0.001$), Some ($p<0.001$), and None at all ($p<0.046$) categories. Personal and FDR Anxiety reported always represented the lowest SDoH score while None Reported/Skipped always represented the highest average SDoH score, this was found to be significant in the A Lot ($p<0.0001$), Some ($p<0.0001$), and None at all ($p<0.016$) categories. ANOVA was run and determined significance in all categories, A Lot ($F(3,38429)=47936$, $p<0.00001$), Some ($F(3,62268)=67514$, $p<0.00001$), and None at all ($F(3,2638)=2499$, $p<0.0001$). Additional post-hoc tests were run and determined significance between all reported/none reported anxiety for all categories; A Lot ($p<0.001$), Some ($p<0.001$), and None at all ($p<0.046$).

Table 20. Average Perceived Stress Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety and No Reported Anxiety

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Anxiety	Only Personal	2.32 ± 1.05	2.15 ± 1.08	1.94 ± 1.18
	Personal and FDR	2.18 ± 1.09	2.03 ± 1.11	1.77 ± 1.22
	Only FDR	2.71 ± 0.89	2.61 ± 0.91	2.21 ± 1.13
	None Reported/Skipped	2.88 ± 0.86	2.79 ± 0.87	2.57 ± 1.05

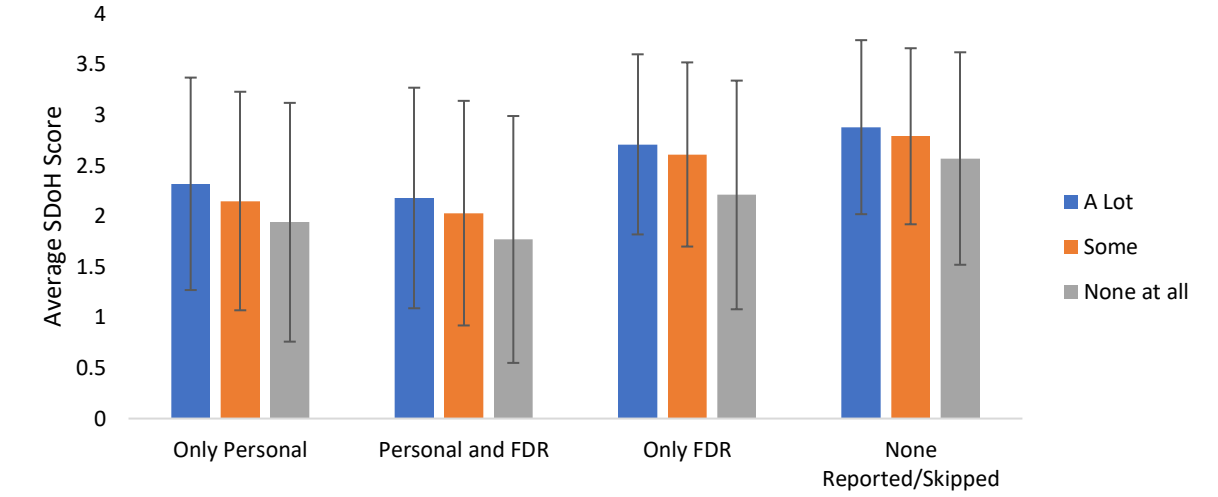

Figure 12a

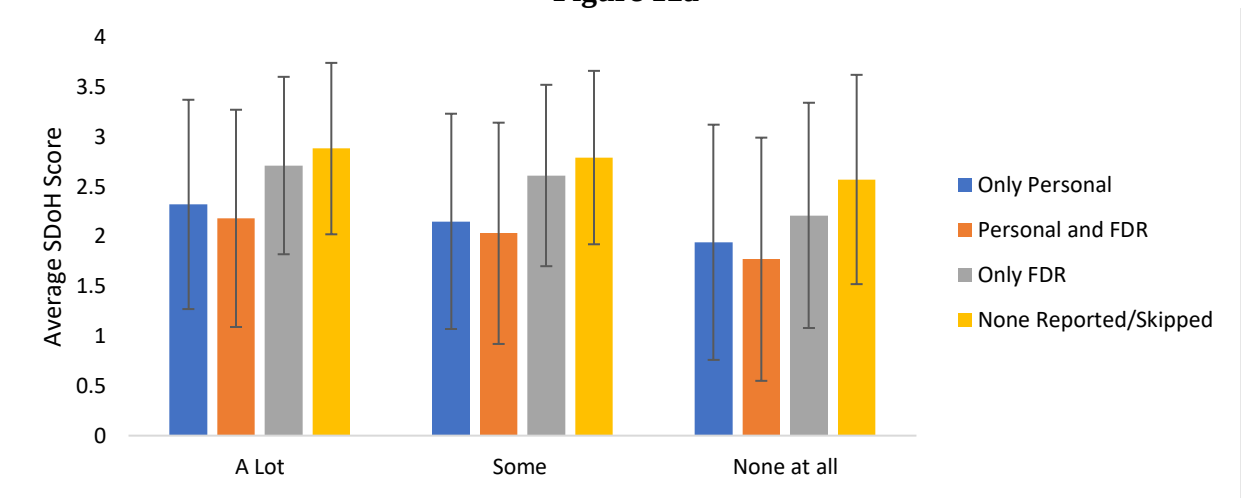

Figure 12b

Average Perceived Stress Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Anxiety, Personal and FDR Anxiety, Only FDR Anxiety, or no Personal and/or FDR Anxiety/Skipped the question altogether, sample size values in Table 11. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-4.

Table 21 displays the Perceived Stress average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of depression. When looking at Figure 13a, the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. This was found to be significant in the Only Personal ($p<0.006$), Personal and FDR ($p<0.008$), and None Reported/Skipped categories ($p<0.001$). ANOVA was run and significance was found in all four categories; Only Personal ($F(2,12862)=7321$, $p<0.00001$), Personal and FDR ($F(2,19212)=3802$, $p<0.00001$), Only FDR ($F(2,8673)=24489$, $p<0.00001$), and None Reported/Skipped ($F(2,56123)=115236$, $p<0.00001$). Additional post-hoc tests were run and significance ($p<0.0001$) was found within the Only Personal, Personal & FDR, and None Reported/Skipped categories. Within the Only FDR category significance was found between A Lot & Some ($p<0.$) and A Lot and None at all ($p<0.$), but significance was not found between Some and None at all ($p<0.055$). Figure 13b compares the average SDoH scores between presence of personal and/or familial depression, or lack or presence. In all three levels of FHH knowledge, Only Personal and Personal & FDR had lower average SDoH scores when compared to those who reported Only FDR and None Reported/Skipped. This was found to be significant in all three categories; A Lot ($p<0.0001$), Some ($p<0.0001$), and None at all ($p<0.006$). Personal and FDR Depression reported represented the lowest SDoH score while None Reported/Skipped represented the highest average SDoH score. This was found to be significant in all three categories; A Lot ($p<0.0001$), Some ($p<0.0001$), and None at all ($p<0.001$). ANOVA was run and determined significance in all categories, A lot ($F(3,27635)=47992$, $p<0.00001$), Some ($F(3,54334)=67907$, $p<0.00001$), and None at all ($F(3,2638)=2509$, $p<0.00001$). Post-hoc tests

were run and determined significance between all reported/none reported depression for the A Lot ($p<0.0001$) and Some ($p<0.0001$) categories. In the None at all category, significance ($p<0.006$) was established between all types of reported/none reported depression except between Only FDR and None Reported/Skipped ($p<0.088$).

Table 21. Average Perceived Stress Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression and No Reported Depression

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Depression	Only Personal	2.43 ± 1.02	2.29 ± 1.05	2.07 ± 1.16
	Personal and FDR	2.28 ± 1.06	2.13 ± 1.09	1.76 ± 1.20
	Only FDR	2.79 ± 0.87	2.69 ± 0.88	2.47 ± 1.06
	None Reported/Skipped	2.92 ± 0.84	2.84 ± 0.85	2.60 ± 1.04

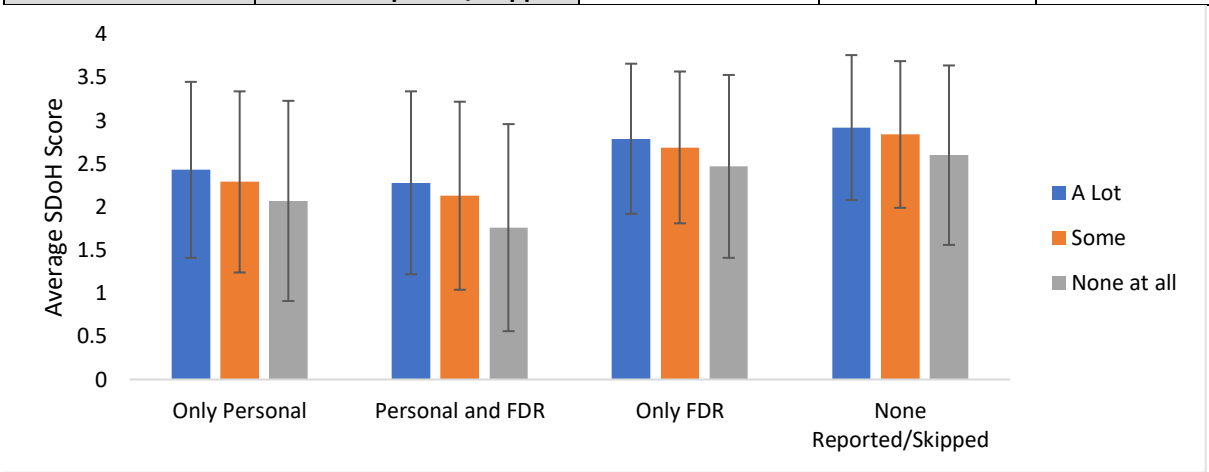

Figure 13a

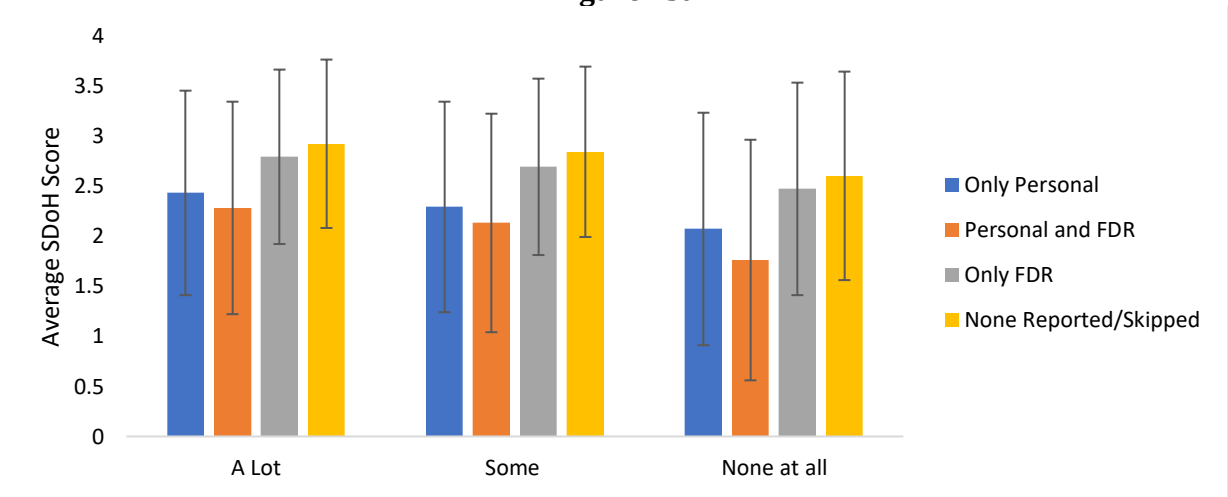

Figure 13b

Average Perceived Stress Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Depression, Personal and FDR Depression, Only FDR Depression, or no Personal and/or FDR Depression/Skipped the question altogether, sample size values in Table 12. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-4.

Table 22 displays the Perceived Stress average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of hypertension. When looking at Figure 14a, the average SDoH score was higher for those who reported A Lot of FHH knowledge, lower in those who reported Some FHH knowledge, and the smallest in those that reported having No FHH knowledge. This was found to be significant in all categories; Only Personal (0.025), Personal and FDR ($p<0.019$), Only FDR ($p<0.01$), and None Reported/Skipped ($p<0.001$). ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10080)=18091$, $p<0.00001$), Personal and FDR ($F(2,23036)=35292$, $p<0.00001$), Only FDR ($F(2,32641)=40223$, $p<0.00001$), and None Reported/Skipped ($F(2,37574)=57114$, $p<0.00001$). Post-hoc tests were run and significance was found within all four categories ($p<0.025$). Figure 14b compares the average SDoH scores between presence of personal and/or familial hypertension, or lack or presence. In all three levels of FHH knowledge, no obvious pattern was seen between the scores. The Only Personal category contained the highest SDoH scores and the Only FDR category contained the lowest SDoH scores in all categories. This finding was found to be significant in the A Lot ($p<0.002$), Some ($p<0.001$), and None at all ($p<0.039$) categories. ANOVA was run and determined significance in all categories; A Lot ($F(3,38425)=41770$, $p<0.00001$), Some ($F(3,62268)=56477$, $p<0.00001$), and None at all ($F(3,2638)=2163$, $p<0.00001$). Post-hoc tests were run for all three categories of FHH Knowledge and significance ($p<0.002$) was found between all categories within the A Lot and Some category. In the None at all category significance was established between all types of reported/none reported hypertension except between Personal & FDR and None Reported/Skipped ($p<0.6$).

Table 22. Average Perceived Stress Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension and No Reported Hypertension

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Hypertension	Only Personal	2.81 ± 0.91	2.77 ± 0.91	2.55 ± 1.07
	Personal and FDR	2.73 ± 0.93	2.64 ± 0.95	2.39 ± 1.16
	Only FDR	2.64 ± 0.95	2.54 ± 0.97	2.22 ± 1.14
	None Reported/Skipped	2.75 ± 0.92	2.62 ± 0.95	2.41 ± 1.10

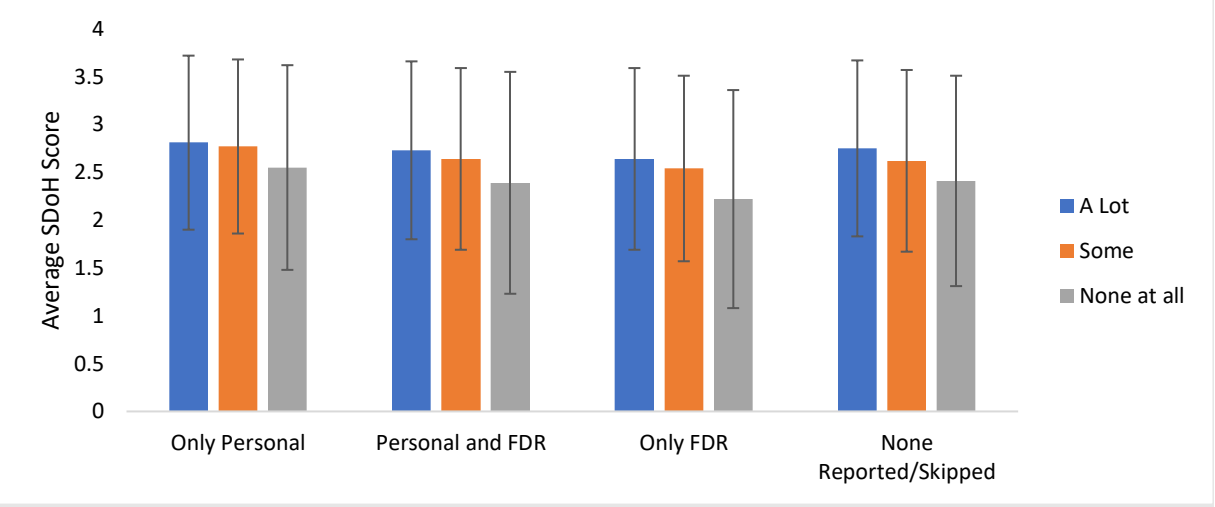

Figure 14a

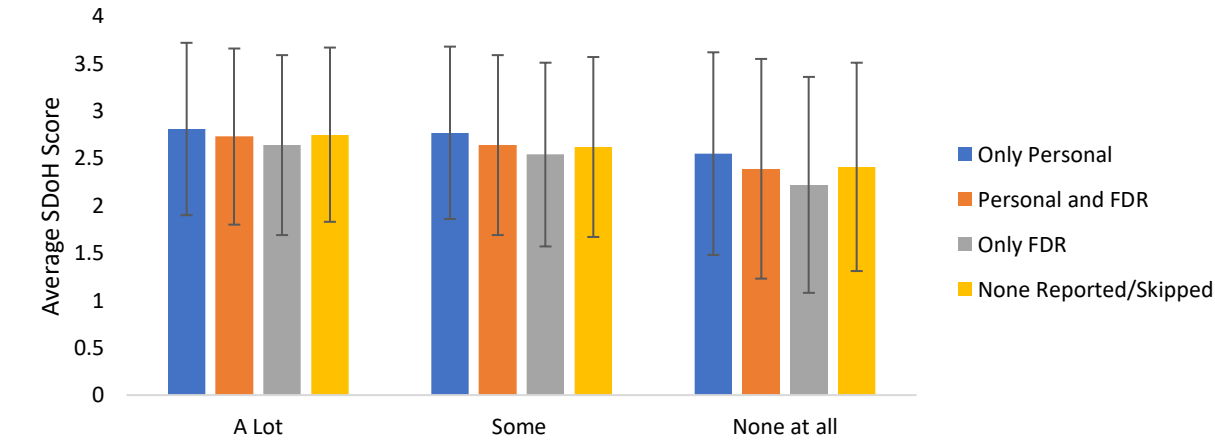

Figure 14b

Average Perceived Stress Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Hypertension, Personal and FDR Hypertension, Only FDR Hypertension, or no Personal and/or FDR Hypertension/Skipped the question altogether, sample size values in Table 13. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-4.

6.3.5 Social Determinant of Health – Religion and Spirituality

Table 23 displays the Religion and Spirituality average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of anxiety. When looking at Figure 15a, no obvious pattern was seen between the scores. Participants who reported Some knowledge consistently had the lowest SDoH score, this finding was significant in the Only Personal ($p<0.032$) and None Reported/Skipped ($p<0.0165$) categories but not found to be significant in the Personal and FDR ($p<0.214$) and Only FDR categories ($p<0.5$). ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10765)=211$, $p<0.00001$), Personal and FDR ($F(2,11992)=171$, $p<0.00001$), Only FDR ($F(2,11376)=116$, $p<0.00001$), and None Reported/Skipped ($F(2,69198)=767$, $p<0.00001$). Additional post-hoc tests were run and significance ($p<0.01$) was found within the Only Personal and None Reported/Skipped categories. Within the Personal and FDR and Only FDR categories significance ($p<0.01$) was found between A Lot and Some but was not found between the remaining categories ($p<0.7$). Figure 15b compares the average SDoH scores between presence of personal and/or familial anxiety, or lack of presence. In all three levels of FHH knowledge, personal anxiety reported had lower average SDoH scores when compared to those who reported no personal presence of anxiety. This was found to be significant in the A Lot ($p<0.001$) and Some ($p<0.001$) categories but not in the None at all ($p<0.7$) category. The None Reported/Skipped category contained the highest scores compared to the other three categories. This was found to be significant in the A Lot ($p<0.012$) and Some ($p<0.014$) categories but not in the None at all ($p<0.3$) category. ANOVA was run and determined significance in all categories, A Lot, Some, and None at all, when comparing the average SDoH scores of reported anxiety. ANOVA was run and determined

significance in all categories, A Lot ($F(3,38429)=268$, $p<0.00001$), Some ($F(3,62268)=623$, $p<0.00001$), and None at all ($F(3,2638)=59$, $p<0.001$). In the A Lot category significance ($p<0.012$) was found between all categories except between Only Personal and Personal & FDR ($p<0.053$). In the Some category significance ($p<0.014$) was found between all categories except between Only Personal and Personal & FDR ($p<0.3$). In the None at all category significance ($p<0.046$) was found between Only Personal & None Reported/Skipped and Personal & FDR and None Reported/Skipped, significance was not found between the remaining categories ($p<0.7$).

Table 23. Average Religion and Spirituality Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety and No Reported Anxiety

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Anxiety	Only Personal	3.11 ± 2.03	2.77 ± 2.0	2.89 ± 2.0
	Personal and FDR	3.06 ± 2.01	2.78 ± 1.97	3.18 ± 2.07
	Only FDR	3.31 ± 2.01	3.07 ± 2.03	3.25 ± 2.02
	None Reported/Skipped	3.38 ± 2.04	3.13 ± 2.04	3.47 ± 2.05

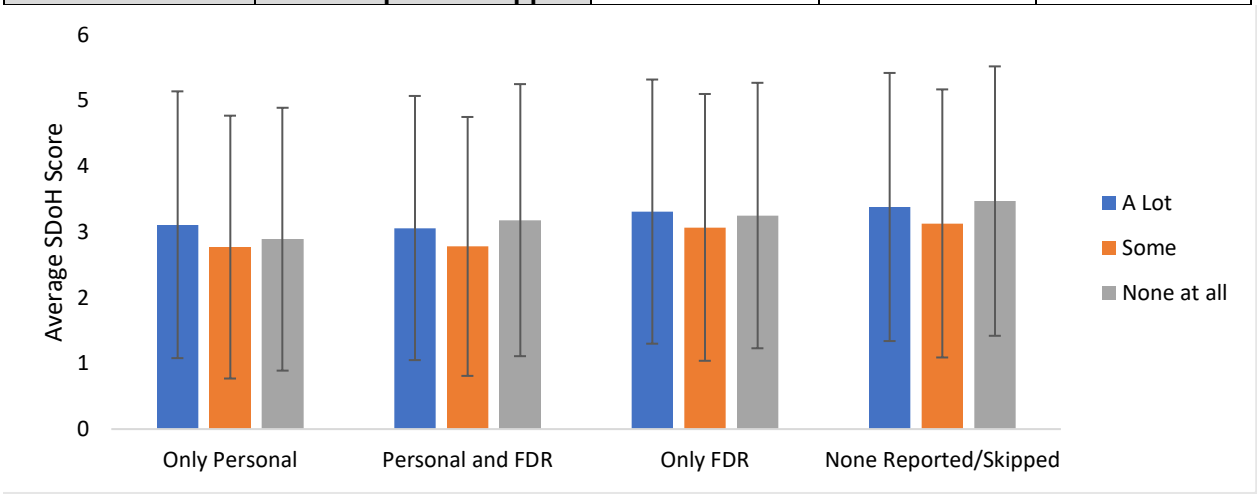

Figure 15a

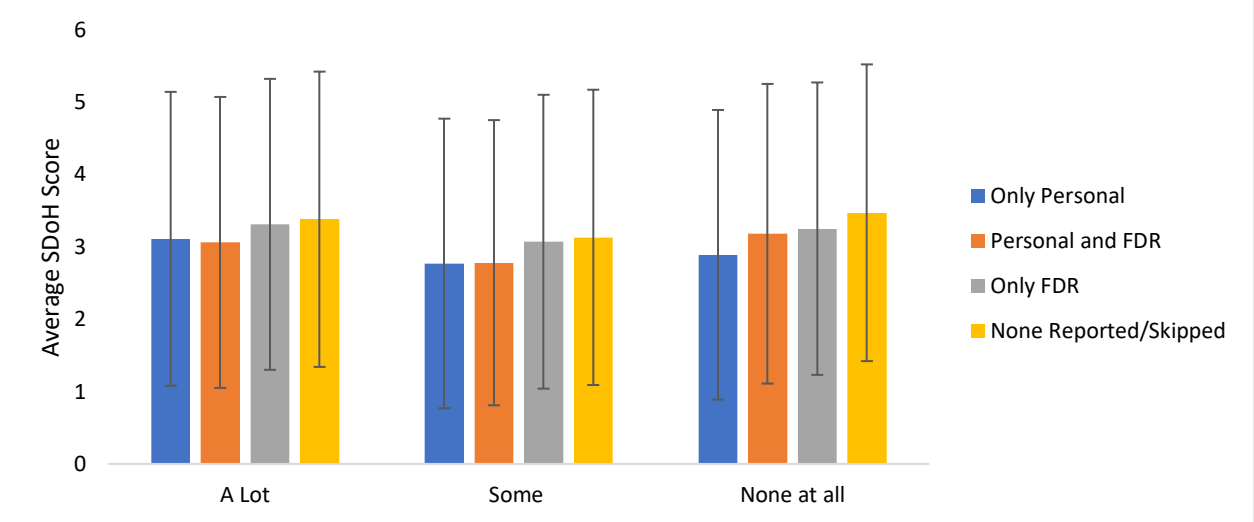

Figure 15b

Average Religion and Spirituality Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Anxiety. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Anxiety, Personal and FDR Anxiety, Only FDR Anxiety, or no Personal and/or FDR Anxiety/Skipped the question altogether, sample size values in Table 11. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-6.

Table 24 displays the Religion and Spirituality average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of depression. When looking at Figure 16a, no obvious pattern was seen between the scores. Participants who reported Some knowledge consistently had the lowest SDoH score, this was found to be significant in the Only Personal ($p<0.0365$) and None Reported/Skipped (0.012) categories but not in the Personal and FDR (0.159) and Only FDR (0.42) categories. ANOVA was run and significance was found in all four categories; Only Personal ($F(2,12862)=160$, $p<0.00001$), Personal and FDR ($F(2,19212)=274$, $p<0.00001$), Only FDR ($F(2,8673)=129$, $p<0.00001$), and None Reported/Skipped ($F(2,56123)=859$, $p<0.00001$). Additional post-hoc tests were run and significance was found within the Only Personal ($p<0.01$) category. Within the Personal and FDR and Only FDR categories significance was found between A Lot and Some ($p<0.001$) but was not found between the remaining categories ($p<0.7$). Within the None Reported/Skipped category significance was found between A lot and Some ($p<0.01$) & Some and None at all ($p<0.013$), while significance was not found between A Lot and None at all ($p<0.13$). Figure 16b compares the average SDoH scores between presence of personal and/or familial depression, or lack of presence. In all three levels of FHH knowledge, reported personal depression had lower average SDoH scores when compared to those who reported no personal depression. This was found to be significant in the A Lot ($p<0.0025$) and Some categories ($p<0.001$), but not in the None at all ($p<0.139$) category. The None Reported/Skipped category contained the highest scores compared to the other three categories. This was found to be significant in the A Lot ($p<0.0001$) and Some ($p<0.0001$) categories, but not in the None at all ($p<0.39$) category. ANOVA was run and determined significance in all categories, A lot ($F(3,27635)=569$,

$p<0.00001$), Some ($F(3,54334)=832$, $p<0.00001$), and None at all ($F(3,2638)=81$, $p<0.00001$). Post-hoc tests were run for all three categories of FHH Knowledge and significance ($p<0.01$) was found between all categories within the A Lot and Some category. In the None at all category significance ($p<0.008$) was established between None Reported/Skipped & Only Personal and None Reported/Skipped and Personal & FDR, significance ($p<0.39$) was not found between the remaining categories.

Table 24. Average Religion and Spirituality Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression and No Reported Depression

		Reported Knowledge of FHH		
		A Lot	Some	None at all
Reported Depression	Only Personal	3.12 ± 2.03	2.84 ± 2.02	2.93 ± 2.03
	Personal and FDR	3.06 ± 2.01	2.78 ± 1.98	3.04 ± 2.02
	Only FDR	3.28 ± 2.05	3.05 ± 2.05	3.37 ± 2.16
	None Reported/Skipped	3.47 ± 2.02	3.18 ± 2.04	3.53 ± 2.04

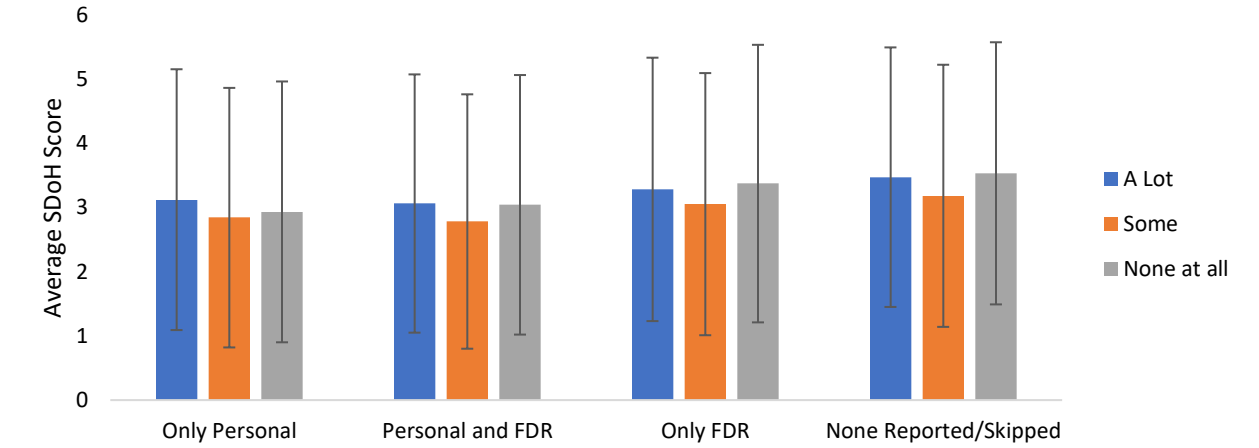

Figure 16a

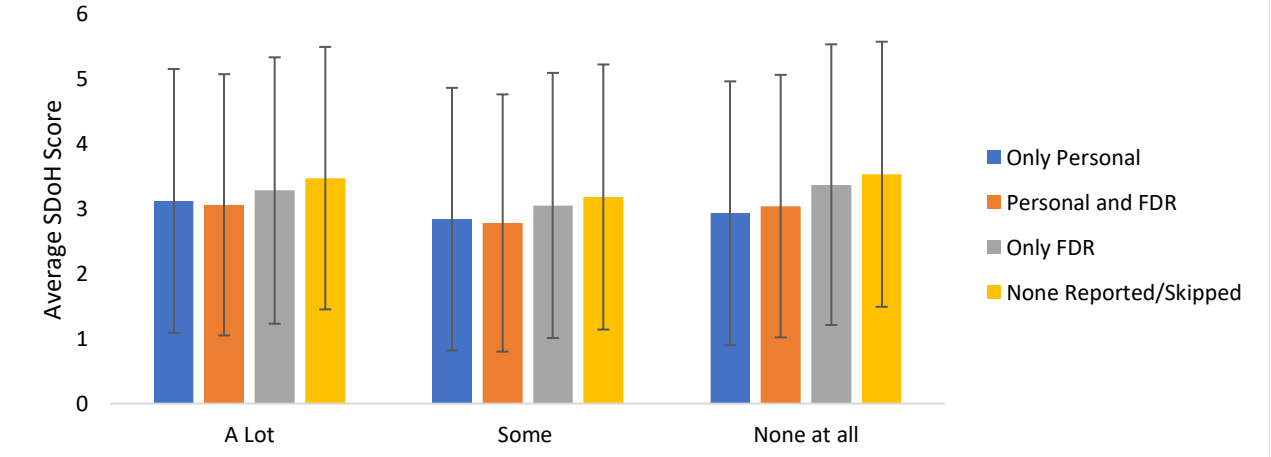

Figure 16b

Average Religion and Spirituality Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Depression. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Depression, Personal and FDR Depression, Only FDR Depression, or no Personal and/or FDR Depression/Skipped the question altogether, sample size values in Table 12. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-6.

Table 25 displays the Religion and Spirituality average SDoH score for those who reported A Lot, Some, and None at all for Knowledge of FHH and those answers are compared by the personal and/or familial presence, or lack of presence, of hypertension. When looking at Figure 17a, the average SDoH score was higher for those who reported No FHH knowledge and lowest for those who reported Some FHH Knowledge. This was not found to be significant in any of the four categories; Only Personal ($p<0.095$), Personal and FDR ($p<0.077$), Only FDR ($p<0.066$), and None Reported/Skipped ($p<0.073$). ANOVA was run and significance was found in all four categories; Only Personal ($F(2,10080)=85.9$, $p<0.00001$), Personal and FDR ($F(2,23036)=244$, $p<0.00001$), Only FDR ($F(2,32641)=376$, $p<0.00001$), and None Reported/Skipped ($F(2,37574)=471$, $p<0.00001$). Additional post-hoc tests were run to determine significance between categories. Within the Only Personal, Personal and FDR, and Only FDR significance ($p<0.001$) was found between A Lot and Some but not between the remaining categories ($p<0.23$). Within the None Reported/Skipped category significance ($p<0.016$) was found between A Lot and Some & Some and None at all, while it was not found between A Lot and None at all ($p<0.073$). Figure 17b compares the average SDoH scores between presence of personal and/or familial hypertension, or lack or presence. In all three levels of FHH knowledge, no personal hypertension reported had lower average SDoH scores when compared to those who reported personal hypertension. This was found to be significant in the A Lot ($p<0.002$) and Some ($p<0.001$) categories, but not in the None at all ($p<0.9$) category. The Personal and FDR category contained the highest scores compared to the other three categories. This was found to be significant in the A Lot ($p<0.004$) and Some ($p<0.0035$) categories, but not in the None at all ($p<0.074$) category. ANOVA was run and determined significance in all categories; A Lot ($F(3,38425)=347$, $p<0.00001$), Some ($F(3,62268)=637$, $p<0.00001$), and None

at all ($F(3,2638)=21.6$, $p<0.00001$). Post-hoc tests were run for all three categories of FHH Knowledge and significance ($p<0.01$) was found between all categories within the Some category. In the A Lot category significance ($p<0.004$) was found between all categories except between Only FDR & None Reported/Skipped ($p<0.154$). In the None at all category significance ($p<0.042$) was established between Only Personal & Personal and FDR, Only Personal & None Reported/Skipped, and Personal and FDR & None Reported/Skipped; significance was not found ($p<0.8$) between the remaining categories.

Table 25. Average Religion and Spirituality Social Determinate of Health (SDoH) score, with standard deviation, by Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) Hypertension and No Reported Hypertension

		Reported Knowledge of FHH		
		A Lot	**Some**	**None at all**
Reported Hypertension	**Only Personal**	3.39 ± 2.04	3.18 ± 2.04	3.50 ± 2.00
	Personal and FDR	3.52 ± 1.99	3.29 ± 2.00	3.79 ± 1.92
	Only FDR	3.22 ± 2.04	2.97 ± 2.03	3.50 ± 2.11
	None Reported/Skipped	3.20 ± 2.06	2.93 ± 2.04	3.28 ± 2.07

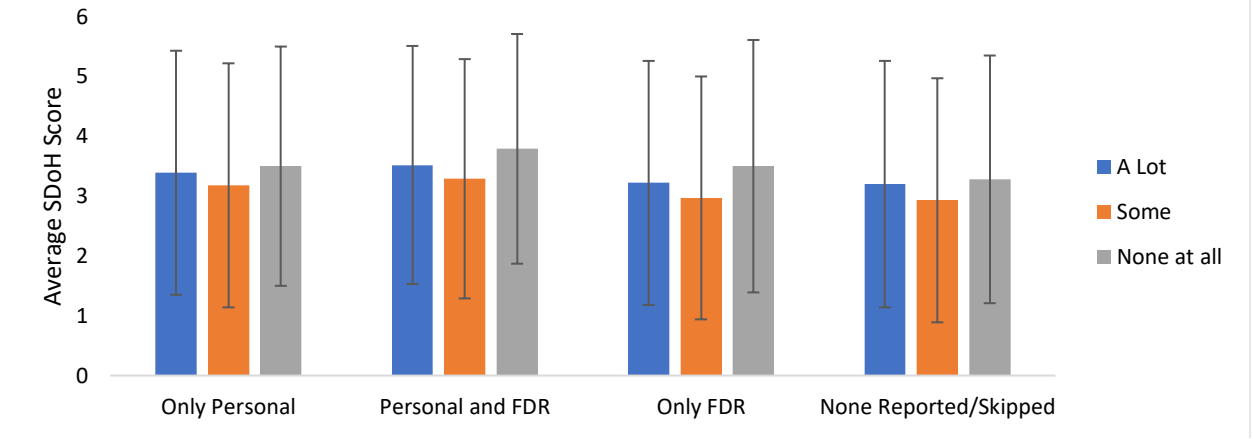

Figure 17a

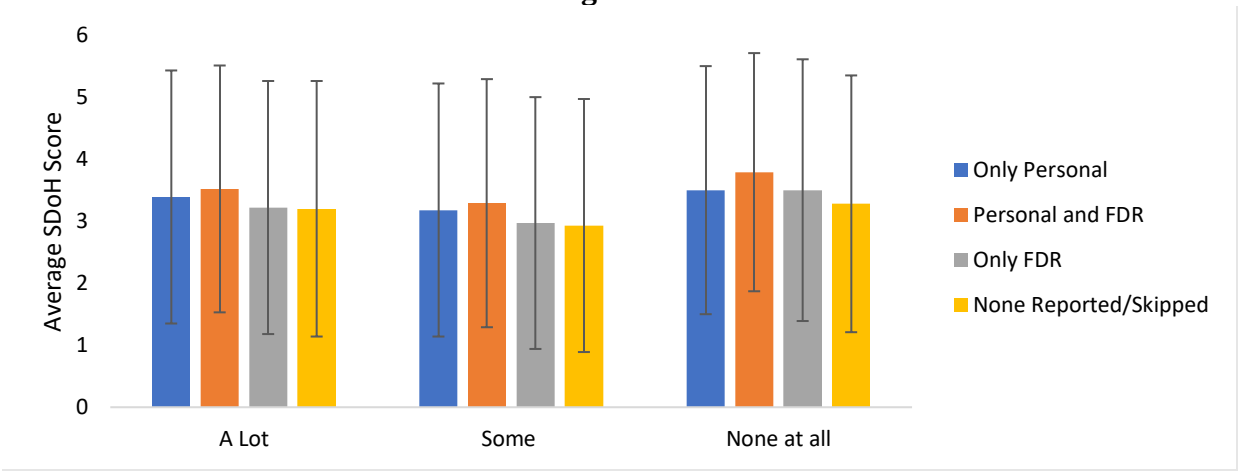

Figure 17b

Average Religion and Spirituality Social Determinant of Health (SDoH) score of Reported Knowledge of Family Health History (FHH) and Reported Presence of Personal and/or First Degree Relative (FDR) score of Reported Knowledge of FHH and Reported Presence of Personal and/or FDR Hypertension. SDoH survey participants who reported their perceived amount of FHH Knowledge and reported presence of Only Personal Hypertension, Personal and FDR Hypertension, Only FDR Hypertension, or no Personal and/or FDR Hypertension/Skipped the question altogether, sample size values in Table 13. Average SDoH of each group was taken and segregated based on SDoH questions answered in relationships category, responses scored 0-6.