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Genetic testing in pregnancies with ultrasound anomalies: Exploration of factors that influence uptake

by

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Genetic testing in pregnancies with ultrasound anomalies: Exploration of factors that influence uptake

A

Thesis

Presented to the Faculty of

The University of Texas

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in Partial Fulfillment

of the Requirements

for the Degree of

Master of Science

by

Lukas Daniel Kruidenier, BA
Houston, Texas

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Genetic testing in pregnancies with ultrasound anomalies: Exploration of factors that influence uptake

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Prenatal genetic diagnostic and screening tests have been rapidly evolving over the past decade with the introduction and expansion of cell free DNA screening (cfDNA) and the use of chromosomal microarray (CMA) as a first-line test for evaluation of fetal anomalies. Understanding patient motivations for or against expanded genetic testing options is paramount, therefore this study aimed to ascertain the patient perspective. Ninety-nine patients with an ultrasound anomaly participated in an anonymous research survey assessing coping strategies, factors influencing the genetic testing decision, and demographic variables. After multivariable analysis, the desire for directive counseling regarding testing was correlated with increased uptake of diagnostic tests (RR 1.52, 95% CI 1.02-2.27). Conversely, higher perceived procedure-related risk reduced uptake of diagnostic testing (RR 0.24, 95% CI 0.10-0.56). Mitigating the risk of genetic testing through expanded cfDNA options will likely further shift how patients evaluate genetic testing decisions in the future. Simultaneously, this raises concerns about the potential for routinization of genetic screening which can hinder informed consent and personalized care. The majority of patients (95%) had some form of genetic testing, despite over 20% not expressing desire for prenatal knowledge of a genetic condition, and 36% not feeling it would impact the medical management of the pregnancy. Mistrust of the medical team was significantly correlated with screening and diagnostic decisions, but the relative degree of effect could not be ascertained. More individuals with high school education or less (23% versus 5% with at least some college education) stated that they would not want the prenatal team to know if there was a genetic condition, whereas race/ethnicity was not significant. Therefore, it appeared that mistrust tracked in our cohort with lower educational attainment

rather than race/ethnicity. This study shows that even with new testing options, the procedure-related risk of diagnostic testing remains a powerful influence on the uptake of genetic testing. Mitigating the perceived risk of genetic testing will likely increase the complexity of the decision-making process for patients and the need for clinicians to provide patient centered counseling to facilitate these decisions.

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Abbreviations

cfDNA	cell free DNA
CI	confidence interval
CMA	chromosomal microarray
FTD	facilitated testing decision; represents any genetic testing (screening or diagnostic) decision provided after counseling at the fetal center
RR	risk ratio
M	mean
MSS	maternal serum screen
SD	standard deviation
ES	exome sequencing

Introduction

Many studies have been performed examining the factors that influence genetic diagnostic and screening test utilization in the prenatal setting. The decision to undergo clinical genetic testing can be complex and should not be solely viewed from the lens of seeking medical knowledge. Factors such as the seriousness of the indication, perceived susceptibility to a genetic condition, anticipated benefit [1], attitudes towards elective abortion [2,3], and perceived risk of the test itself [2-6] have been shown to impact decision-making.

Acknowledging how the field of prenatal testing has evolved in recent years is critical in understanding genetic testing decisions. Since its introduction in the United States in 2011, cell-free DNA testing (cfDNA) has decreased invasive testing (particularly amniocentesis) [7-11] and maternal serum screening utilization [7,9,11]. Additionally, there have been examples of changes in the nature of referrals for genetic counseling and diagnostic testing [9, 10]. For instance, there are more referrals for carrier screening, ultrasound anomalies, and significant family history with a relative decrease in the number of referrals for advanced maternal age and abnormal maternal serum screens [10]. Now cfDNA stands as the recommended screening modality for all pregnant women [12]. While current recommendations for cell-free DNA screening only encompass trisomy 21, 18, 13 and certain sex chromosome abnormalities, the capability of cfDNA reaches far beyond detection of viable aneuploidies. Cell-free DNA screening is clinically available for select microdeletion syndromes, genome wide deletions and duplications as well as select monogenic disorders. Additionally, genetic testing advances have expanded routine diagnostic testing beyond karyotype alone. Chromosomal microarray is recommended as a first line diagnostic test in the presence of a fetal anomaly [13] and exome sequencing is poised to become the next step in the presence of fetal anomalies [14-16].

The utilization of genetic testing in pregnancies with fetal anomalies is of particular interest, as these pregnancies are at higher risk to have an underlying genetic condition. Studies have shown that uptake of genetic testing is higher when an ultrasound abnormality is detected [17-19] and the yield of testing is higher in these pregnancies [16, 20-22]. However, little has been elucidated about how patients'

make testing decisions in the context of an ultrasound anomaly. Due to the complexities of the decision-making process, it is unclear what factors weigh most heavily on this decision.

It is also unclear how the mitigation of obstacles to testing such as cost and risk may impact testing uptake. Decision making may shift towards the ultimate question of whether a patient finds value in a prenatal diagnosis. Clinicians need the insight to tailor pre-test counseling using a patient centered framework to elicit the underlying motivations. These motivations may not be as tangible as eliminating risk and reducing cost.

This study aimed to examine and broaden our knowledge of potential decision-making factors related to genetic testing in pregnancies with fetal anomalies. We aimed to both validate previously identified factors, but also consider other potential psychosocial aspects of the decision-making process in the light of new testing options. We examined the coping strategies of patients, patient's perceptions of the care team, and social factors to determine if there were any specific facets to consider during pre-test counseling. This information may help clinicians better understand patients' decision making and provide better care during a vulnerable period in their pregnancy.

Methods

This was a cross-sectional, single site study performed at a tertiary maternal-fetal medicine center at Children's Memorial Hermann Hospital in Houston, Texas from July 2020 to February 2021. IRB approval for the study protocol was obtained through the University of Texas Health Science Center Review Board (HSC-GEN-19-0479).

Participants in the study had to be 18 years or older, English or Spanish speaking, and referred to genetic counseling for a fetal anomaly. After the patient consented to the study, the genetic counselor recorded demographic information including maternal age, gestational age, genetic testing history, obstetric history, and a brief explanation of the reason for referral in a study log. No protected health information was documented by the counselor and the medical record was not accessed for the purposes of the study after the appointment.

Prior to genetic counseling, the patient was provided the Coping Strategy Indicator [23]. This is a validated, 33-question, Likert-scale tool that assesses three strategies of coping: problem-solving, social support seeking, and avoidance in the context of typical behaviors in previous stressful situations. Responses are categorized based on the provided scale which corresponds to the likelihood that an individual would utilize each coping strategy . The survey was offered prior to meeting the medical team to minimize the direct influence of the consultation on the reporting of typical coping strategies.

After the genetic consultation was completed and the testing decision was made, patients were asked to complete a second survey, coded to the first survey response and study log, designed to assess for various factors that may have influenced the genetic testing decision. These factors broadly focused on concern for the indication, perceived utility and risk of the testing, the influence of the medical team, social decision making, and the influence of a belief system. Patients reported these factors via a 20 question four-point Likert scale. Additional demographic information such as educational attainment, belief system, and marital status was provided by the patient. This measure was not validated. Patients who participated in the study were offered entry into a drawing where the identifying information was separate from their survey responses.

Demographics, coping strategy, and decision-making factors were correlated with the patient's genetic testing decision. In the analysis of the factors influencing the testing decision, the Likert items (strongly agree, agree, disagree, strongly disagree) were reduced to binary results (agree, disagree). Concern was reduced (none, minimal, some, a great deal) to low and high concern. Experience with disability or special needs was reduced (none, minimal, some, a great deal) to less and more experience. The genetic testing decision was examined through two lenses: whether they accepted diagnostic testing at any point and whether they elected any new testing (screening or diagnostic) after counseling at the fetal center. The latter group is referred to as 'Facilitated Testing Decisions' (FTD). Screening decisions could include those who had maternal serum screening (MSS) and elected cfDNA, repeat cfDNA for various reasons including low fetal fraction, additional cfDNA analysis for microdeletions and duplications not previously examined, or carrier screening. Patients who were seeking fetal intervention

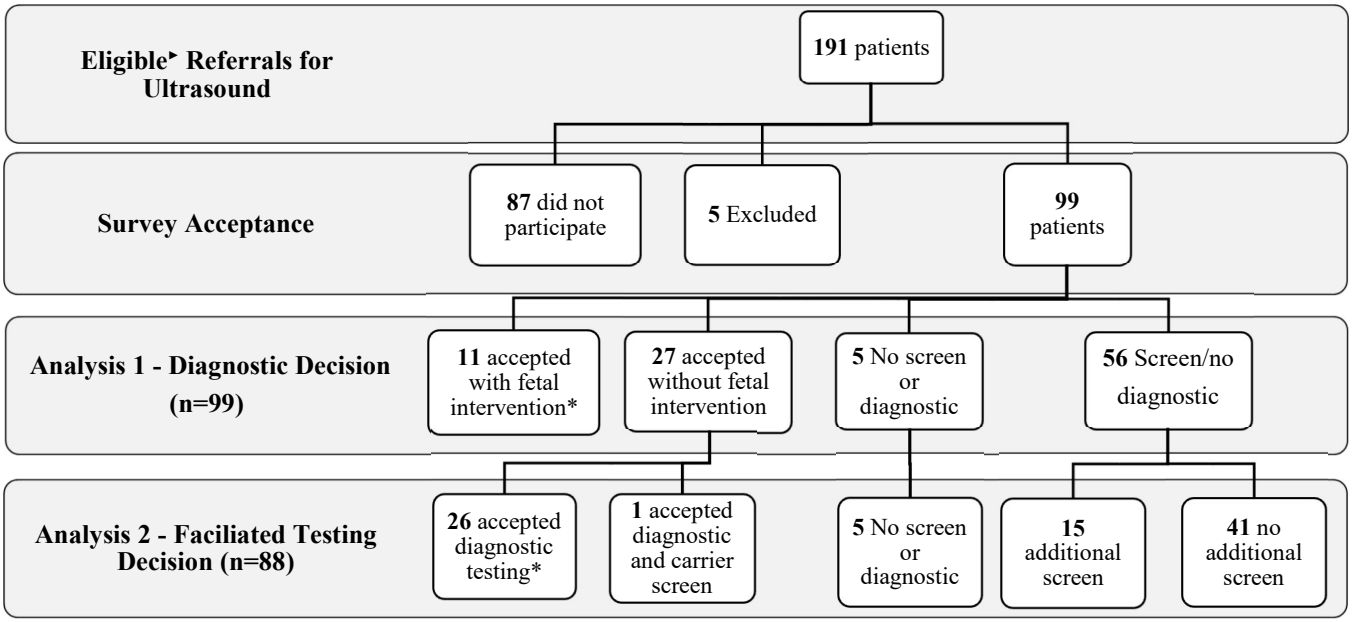
(e.g. in utero repair for a neural tube defect) were excluded from the FTD analysis as diagnostic testing is required for these patients which could confound the results. Pearson χ^2 or Fisher's exact tests were used for categorical analyses. Multivariable Poisson regression models with robust error variance were utilized to evaluate the association between factors and the outcomes. Crude and adjusted risk ratios (RRs) were reported with 95% confidence intervals (CI). Two-sided student's T-tests were used for evaluation of age-related variables. χ^2 goodness of fit was utilized to evaluate if the study sample was racially representative of the population surrounding Harris County. Significance was assumed at $p<0.05$. Analysis was performed utilizing STATA (v.13.1, College Station, TX) and Jamovi (v.1.6) statistical software.

Results

Study Participation and Analysis Groups

One hundred-four patients out of an estimated 191 eligible patients participated in the study during the specified timeframe (54.4%), (Figure 1).

***Figure 1* – Participation, Analyses, and Testing Decision**



˃An eligible referral for ultrasound is considered an ultrasound finding with a known association with a genetic etiology

*Twenty-two had genetic screening prior to terminal diagnostic testing decision (n=4 fetal intervention patients; n=18 patients who did not consider fetal intervention)

Eighty-seven eligible patients did not participate, either due to time constraints prohibiting administration of the survey or because patients declined participation. Five surveys were excluded based on indication or irregularities with the survey. The remaining 99 patient responses were used in the analysis. Ten surveys (9.9%) were from Spanish-speaking patients. Evidence of previous screening (cfDNA, carrier screening, or maternal serum screening) was noted for 78 (78.8%) patients. Five (5.1%) individuals had declined all diagnostic and screening tests before and after the fetal center consult.

Demographics and Diagnostic Testing Decision

Demographic characteristics of study participants and their association with diagnostic testing uptake are described in Table 1. This cohort was believed to be representative of the known racial demographics for Harris County, Texas based on 2019 census data[24] and χ^2 goodness of fit testing (df=4, p=0.81).

Educational attainment ($p=0.034$), insurance status ($p=0.030$), and trimester ($p=0.039$) were all significantly correlated with the diagnostic testing decision. Specifically, those with higher education, private insurance, and in the first and second trimester of pregnancy were more likely to undergo diagnostic testing based on relative proportions.

***Table 1* – Demographic Information and Diagnostic Testing Decision**

Variable	Total (n=99)	% Total	Diagnostic Decision: Yes (n=38)	% of Yes	No (n=61)	% of No	p-value
Maternal Age (Mean†/SD‡)	28.1†	6.2‡	29.6†	6.4‡	27.1†	6.0‡	0.053
Race/Ethnicity							0.27
White, Non-Hispanic	27	27.3	14	36.8	13	21.3	
Black/African American	22	22.2	9	23.7	13	21.3	
Hispanic	40	40.4	11	28.9	29	47.5	
Other	9	9.1	4	10.5	5	8.2	
Unknown	1	1.0	0	0.0	1	1.6	
Education							**0.034**
Less than high school	10	10.1	3	7.9	7	11.5	
High school graduate	28	28.3	5	13.2	23	37.7	
Some college	29	29.3	13	34.2	15	24.6	
College graduate or above	32	32.3	16	42.1	16	26.2	
Unknown	1	1.0	1	2.6	0	0.0	
Marital Status							0.067
Married/partner	70	70.7	30	78.9	40	65.6	
Not married	28	28.3	7	18.4	21	34.4	
Unknown	1	1.0	1	2.6	0	0.0	
Insurance Status							**0.030**
Public	53	53.5	15	39.5	38	62.3	
Private	45	45.5	23	60.5	22	36.1	
Uninsured/Self-Pay	1	1.0	0	0.0	1	1.6	
Trimester							**0.039**
First (≤13 weeks)	3	3.0	3	7.9	0	0.0	
Second (14-26 weeks)	63	63.6	28	73.7	35	57.4	
Third (≥27 weeks)	33	33.3	7	18.4	26	42.6	
Gravidity							0.96
Primigravida	31	31.3	12	31.6	19	31.1	
Multigravida	68	68.7	26	68.4	42	68.9	
Parity							0.93
Nulliparous	46	46.5	17	44.7	29	47.5	
Uniparous	29	29.3	11	28.9	18	29.5	
Multiparous	24	24.2	10	26.3	14	23.0	
Previous Genetic Counseling							0.68
Yes	34	34.3	14	36.8	20	32.8	
No	65	65.7	24	63.2	41	67.2	
Religious							0.40
Yes	80	80.8	29	76.3	51	83.6	
No	8	8.1	5	13.2	3	4.9	
Unknown	11	11.1	4	10.5	7	11.5	

p-values calculated using a χ^2 or Fisher's exact test except for age variable calculated with a two-tailed student's T-test (bolded significant at $p<0.05$)

Factors Influencing the Diagnostic Testing Decision

A number of decision-making factors were significantly correlated with the diagnostic testing decision (Tables 2a, 2b). The four-point Likert-data is available in the tables under Appendix A.

Table 2a **- Diagnostic Testing and Decision-Making Factors**

	Total (n=99)	Yes (n=38)	No (n=61)	% yes	p-value
Rate your level of concern for a genetic condition					0.138
Low Concern	35	10	25	28.6	
High Concern	64	28	36	43.8	
Describe your experience or amount of interaction with individuals with special needs, physical or intellectual disabilities or genetic conditions					0.96
Less Experience	57	22	35	38.6	
More Experience	42	16	26	38.1	
I feel that invasive testing (amniocentesis or CVS) is too risky to the pregnancy					**<0.001**
Agree	48	5	43	10.4	
Disagree	47	32	15	68.1	
Unknown	4	1	3	25.0	
I have a fear of needles and/or invasive procedures					0.116
Agree	49	15	34	30.6	
Disagree	50	23	27	46.0	
I feel that genetic testing could explain what caused the ultrasound finding in my pregnancy					**0.026**
Agree	76	34	42	44.7	
Disagree	23	4	19	17.4	
I feel that I understood the genetic testing options and was able to make an informed choice					0.295
Agree	95	38	57	40.0	
Disagree	4	0	4	0.0	
If there was a genetic condition, I would like to know about it before delivery					**<0.001**
Agree	75	37	38	49.3	
Disagree	22	1	21	4.5	
Unknown	2	0	2	0.0	
The opinion of my partner or family member is important in helping me decide whether to have genetic testing					**0.008**
Agree	81	36	45	44.4	
Disagree	18	2	16	11.1	
The opinion of a friend is important in helping me decide whether to have genetic testing					0.711
Agree	19	8	11	42.1	
Disagree	80	30	50	37.5	
My religious faith influenced my genetic testing decision					0.933
Agree	23	9	14	39.1	
Disagree	76	29	47	38.2	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)
'% yes' represents the proportion of individuals that accepted diagnostic testing grouped by response

Table 2b **- Diagnostic Testing and Decision-Making Factors**

	Total (n=99)	Yes (n=38)	No (n=61)	% yes	p-value
My belief in the spiritual influenced my genetic testing decision					0.882
Agree	23	8	15	34.8	
Disagree	75	30	45	40.0	
Unknown	1	0	1	0.0	
Genetic testing would conflict with my faith					0.125
Agree	4	0	4	0.0	
Disagree	94	37	57	39.4	
Unknown	1	1	0	100.0	
I believe that genetic testing is being offered in my best interest					**0.020**
Agree	92	37	55	40.2	
Disagree	6	0	6	0.0	
Unknown	1	1	0	100.0	
I would want my medical team to know if there was a genetic condition before delivery					**0.012**
Agree	89	38	51	42.7	
Disagree	10	0	10	0.0	
If there was a genetic condition, it would change the way I medically manage my pregnancy					**0.012**
Agree	63	30	33	47.6	
Disagree	36	8	28	22.2	
If there was a genetic condition, it would change the way I feel about my pregnancy					0.203
Agree	28	13	15	46.4	
Disagree	70	24	46	34.3	
Unknown	1	1	0	100.0	
I did not feel pressured to undergo genetic testing					1.00
Agree	91	35	56	38.5	
Disagree	8	3	5	37.5	
I feel that I had adequate input from the medical team in making a decision about genetic testing					1.00
Agree	98	38	60	38.8	
Disagree	1	0	1	0.0	
I feel that I had adequate input from family and friends in making a decision about genetic testing					0.659
Agree	78	32	46	41.0	
Disagree	20	6	14	30.0	
Unknown	1	0	1	0.0	
I would have liked the genetic counselor or doctor to tell me if I should get genetic testing or not					**0.041**
Agree	42	21	21	50.0	
Disagree	57	17	40	29.8	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)
'% yes' represents the proportion of individuals that accepted diagnostic testing grouped by response

Decision-making factors that were significantly correlated with diagnostic testing uptake included the affirmation that genetic testing could explain the ultrasound finding in the pregnancy ($p=0.026$), knowing about a genetic condition would be helpful before delivery ($p<.001$), the opinion of the partner or family member is important to the decision ($p=0.0008$), testing was being offered in the patient's best interest ($p=0.020$), they would want the medical team to know if there was a genetic condition during the pregnancy ($p=0.012$), a genetic condition would change medical management of the pregnancy ($p=0.012$) and they would have liked the medical team to be more directive about testing ($p=0.041$). The only factor significantly associated with the decision to decline diagnostic testing was the belief that diagnostic testing was too risky to the pregnancy ($p<0.001$).

Demographics and Facilitated Testing Decision (FTD)

After excluding patients who underwent diagnostic testing as an eligibility requirement for fetal intervention, demographics and testing decision were evaluated for the remaining 88 patients (Table 3).

***Table 3* – Demographic Information and Facilitated Testing Decision**

Variable	Total (n=88)	% Total	Facilitated Testing Decision				
			Yes (n=42)	% of Yes	No (n=46)	% of No	p-value
Maternal Age (Mean†/SD‡)	28.1†	6.1‡	29.5†	6.0‡	26.8†	5.9‡	**0.033**
Race/Ethnicity							0.29
White, Non-Hispanic	22	25.0	10	23.8	12	28.6	
Black/African American	21	23.9	14	33.3	7	16.7	
Hispanic	37	42.0	15	35.7	22	52.4	
Other	7	8.0	3	7.1	4	9.5	
Unknown	1	1.1	0	0.0	1	2.4	
Education							0.45
Less than high school	9	10.2	3	7.1	6	14.3	
High school graduate	24	27.3	9	21.4	15	35.7	
Some college	25	28.4	14	33.3	11	26.2	
College graduate or above	29	33.0	15	35.7	14	33.3	
Unknown	1	1.1	1	2.4	0	0.0	
Marital Status							0.90
Married/partner	60	68.2	28	66.7	32	76.2	
Not married	27	30.7	13	31.0	14	33.3	
Unknown	1	1.1	1	2.4	0	0.0	
Insurance Status							0.91
Public	49	55.7	23	54.8	26	61.9	
Private	38	43.2	19	45.2	19	45.2	
Uninsured/Self-Pay	1	1.1	0	0.0	1	2.4	
Trimester							0.15
First (≤13 weeks)	3	3.4	3	7.1	0	0.0	
Second (14-26 weeks)	56	63.6	30	71.4	26	61.9	
Third (≥27 weeks)	29	33.0	9	21.4	20	47.6	
Gravidity							0.51
Primigravida	26	29.5	11	26.2	15	35.7	
Multigravida	62	70.5	31	73.8	31	73.8	
Parity							0.56
Nulliparous	42	47.7	18	42.9	24	57.1	
Uniparous	25	28.4	12	28.6	13	31.0	
Multiparous	21	23.9	12	28.6	9	21.4	
Previous Genetic Counseling							0.76
Yes	30	34.1	15	35.7	15	35.7	
No	58	65.9	27	64.3	31	73.8	
Religious							0.60
Yes	72	81.8	34	81.0	38	90.5	
No	6	6.8	4	9.5	2	4.8	
Unknown	10	11.4	4	9.5	6	14.3	

p-values calculated using a χ^2 or Fisher's exact test except for age variable calculated with a two-tailed student's T-test (bolded significant at $p<0.05$)

Of these patients, 42 (47.7%) elected to pursue some form of diagnostic or screening test. Diagnostic testing was elected in 27 (30.7%) cases, 18 of which had previous screening. Sixteen (18.2%) elected a screening test, 14 of which had previous screening. Forty-one (46.6%) had screening prior to the appointment and did not have further screening or diagnostic testing. The remaining five declined all testing, prior to and after their fetal center consultation.

Age was significantly correlated with increased screening/diagnostic testing uptake in the FTD group (p=.033). Those who elected any new testing tended to be older compared to those who declined testing (Table 3). No other demographic factors were significantly correlated with testing decision.

Factors Influencing the Fetal Center Facilitated Testing Decision

A number of decision-making factors were also correlated diagnostic and screening decision within the FTD cohort (Table 4a, 4b). The four-point Likert-data is available in the tables under Appendix A.

Table 4a - **Facilitated Testing Decision and Decision-Making Factors**

	Total (n=88)	Yes (n=42)	No (n=46)	% yes	p-value
Rate your level of concern for a genetic condition					**<0.001***
Low Concern	28	6	22	21.4	
High Concern	60	36	24	60.0	
Describe your experience or amount of interaction with individuals with special needs, physical or intellectual disabilities or genetic conditions					0.723
Less Experience	52	24	28	46.2	
More Experience	36	18	18	50.0	
I feel that invasive testing (amniocentesis or CVS) is too risky to the pregnancy					**<0.001**
Agree	45	13	32	28.9	
Disagree	39	28	11	71.8	
Unknown	4	1	3	25.0	
I have a fear of needles and/or invasive procedures					0.200
Agree	44	18	26	40.9	
Disagree	44	24	20	54.5	
I feel that genetic testing could explain what caused the ultrasound finding in my pregnancy					**<0.001**
Agree	68	41	27	60.3	
Disagree	20	1	19	5.0	
I feel that I understood the genetic testing options and was able to make an informed choice					0.118
Agree	84	42	42	50.0	
Disagree	4	0	4	0.0	
If there was a genetic condition, I would like to know about it before delivery					**0.002**
Agree	64	37	27	57.8	
Disagree	22	4	18	18.2	
Unknown	2	1	1	50.0	
The opinion of my partner or family member is important in helping me decide whether to have genetic testing					0.092
Agree	71	37	34	52.1	
Disagree	17	5	12	29.4	
The opinion of a friend is important in helping me decide whether to have genetic testing					0.951
Agree	17	8	9	47.1	
Disagree	71	34	37	47.9	
My religious faith influenced my genetic testing decision					0.805
Agree	22	11	11	50.0	
Disagree	66	31	35	47.0	

p-values calculated with either χ^2 , Fisher's exact tests, or two-tailed Student's T-test (bolded $p<0.05$)
'% yes' represents the proportion of individuals that accepted diagnostic testing grouped by response

Table 4b **- Facilitated Testing Decision and Decision-Making Factors**

	Total (n=88)	Yes (n=42)	No (n=46)	% Yes	p-value
My belief in the spiritual influenced my genetic testing decision					0.601
Agree	22	10	12	45.5	
Disagree	65	32	33	49.2	
Unknown	1	0	1	0.0	
Genetic testing would conflict with faith					0.118
Agree	4	0	4	0.0	
Disagree	83	41	42	49.4	
Unknown	1	1	0	100.0	
I believe that genetic testing is being offered in my best interest					**0.027**
Agree	81	41	40	50.6	
Disagree	6	0	6	0.0	
Unknown	1	1	0	100.0	
I would want my medical team to know if there was a genetic condition before delivery					**0.016**
Agree	78	41	37	52.6	
Disagree	10	1	9	10.0	
If there was a genetic condition, it would change the way I medically manage my pregnancy					**0.011**
Agree	55	32	23	58.2	
Disagree	33	10	23	30.3	
If there was a genetic condition, it would change the way I feel about my pregnancy					0.649
Agree	27	14	13	51.9	
Disagree	61	28	33	45.9	
I did not feel pressured to undergo genetic testing					1.00
Agree	81	39	42	48.1	
Disagree	7	3	4	42.9	
I feel that I had adequate input from the medical team in making a decision about genetic testing					1.00
Agree	87	42	45	48.3	
Disagree	1	0	1	0.0	
I feel that I had adequate input from family and friends in making a decision about genetic testing					0.507
Agree	70	32	38	45.7	
Disagree	17	9	8	52.9	
Unknown	1	1	0	100.0	
I would have liked the genetic counselor or doctor to tell me if I should get genetic testing or not					0.152
Agree	33	19	14	57.6	
Disagree	55	23	32	41.8	

p-values calculated with either χ^2 , Fisher's exact tests, or two-tailed Student's T-test (bolded $p<0.05$)
'% yes' represents the proportion of individuals that accepted diagnostic testing grouped by response

Patients with the FTD group were more likely to elect diagnostic testing if they believed: genetic testing could explain the ultrasound finding in the pregnancy ($p<.001$), knowing about a genetic condition would be helpful before delivery ($p=0.002$), testing was being offered in the patient's best interest ($p=0.027$), they would want the medical team to know if there was a genetic condition during the pregnancy ($p=0.016$), and testing would change medical management of the pregnancy ($p=0.011$). The factors significantly related to the decision to decline any further testing (or no testing at all in the case of five patients) included the patient's belief that diagnostic testing was too risky to the pregnancy ($p<0.001$), and that the patient's level of concern for a genetic condition was low ($p<.001$).

Multivariable Models

Multivariable Poisson regression models with robust error variance were used to evaluate the association between factors and outcomes. Adjustments were made for all significant decision-making factors and demographic variables in both the diagnostic and FTD cohort (Table 5, 6).

Table 5 – Multivariable Analysis of Diagnostic Testing Decision

	p-value	Crude RR (95% CI)	Adj RR* (95% CI)
Risk of invasive testing	**<0.001**		
Agree		**0.15 (0.06-0.36)**	**0.24(0.10-0.56)**
Disagree		1.00	1.00
Unknown		0.37 (0.07-2.05)	0.38(0.08-1.93)
Genetic testing can explain finding	**<0.001**		
Agree		**2.57 (1.02-6.52)**	1.06(0.44-2.55)
Disagree		1.00	1.00
Knowledge is useful at this time	**0.002**		
Agree		**10.86 (1.56-75.48)**	5.84(0.91-37.31)
Disagree		1.00	1.00
Unknown		-	-
Opinion of partner	**0.008**		
Agree		**4.00 (1.05-15.21)**	2.22(0.81-6.03)
Disagree		1.00	1.00
Change in medical management	**0.012**		
Agree		**2.14 (1.10-4.18)**	1.47(0.81-2.70)
Disagree		1.00	1.00
Directive	**0.041**		
Agree		**1.68 (1.01-2.77)**	**1.52(1.02-2.27)**
Disagree		1.00	1.00
Education	**0.45**		
Less than High School		0.60 (0.22-1.65)	1.25(0.60-2.59)
High school graduate		**0.36 (0.15-0.85)**	0.76(0.30-1.93)
Some college		0.93 (0.55-1.58)	0.72(0.42-1.25)
College graduate or above		1.00	1.00
Unknown		**2.00 (1.41-2.83)**	0.83(0.47-1.46)
Insurance	**0.030**		
Public		1.00	1.00
Private		**1.81(1.08-3.03)**	1.05(0.64-1.70)
Uninsured/Self-Pay		-	-
Trimester	**0.039**		
First (≤13 weeks)		**4.71 (2.43-9.13)**	1.57(0.75-3.32)
Second (14-26 weeks)		**2.10 (1.02-4.29)**	1.03(0.55-1.94)
Third (≥=27 weeks)		1.00	1.00

p-values calculated with either χ^2 , Fisher's exact tests, or two-tailed Student's T-test
Bolded are significant at 95% confidence
*risk ratio (RR) after adjusting for: perceived risk of invasive testing, belief that testing can find the cause of the ultrasound finding, belief the knowledge of a genetic condition has value, the opinion of family or partner is important to the decision, desire for the medical team to be directive, education, insurance, trimester

Table 6 -Multivariable Analysis of Facilitated Testing Decision

	p-value	Crude RR (95% CI)	Adj RR* (95% CI)
Level of concern for a genetic condition	**<.001**		
Low Concern		**0.36 (0.17-0.75)**	0.73(0.36-1.47)
High Concern		1.00	1.00
Risk of invasive testing	**<.001**		
Agree		**0.40 (0.24-0.66)**	0.68(0.43-1.08)
Disagree		1.00	1.00
Unknown		0.35 (0.06-1.94)	0.28(0.05-1.46)
Genetic testing can explain finding	**<.001**		
Agree		**12.06 (1.75-83.17)**	6.10 (0.73-50.90)
Disagree		1.00	1.00
Knowledge is useful at this time	**0.002**		
Agree		**3.18 (1.27-7.95)**	1.93(0.81-4.60)
Disagree		1.00	1.00
Unknown		2.75 (0.53-14.28)	1.64(0.26-10.46)
Change in medical management	**0.011**		
Agree		**1.92 (1.09-3.39)**	1.27(0.76-2.11)
Disagree		1.00	1.00
Maternal age	**0.03**	1.03(0.99-1.06)	1.02(0.99-1.05)

p-values calculated with either χ^2 , Fisher's exact tests, or two-tailed Student's T-test
Bolded are significant at 95% confidence
*risk ratio (RR) after adjusting for: level of concern for a genetic condition, perceived risk of invasive testing, belief that testing can find the cause of the ultrasound finding, belief the knowledge of a genetic condition has value, testing would change management of the pregnancy, and age

The responses to, 'I believe that genetic testing is being offered in my best interest' and 'I would want my medical team to know if there was a genetic condition before delivery', were excluded from the analyses due to an inadequate comparison group. Only one patient had elected screening after disagreeing with wanting the medical team to know if there was a genetic condition.

The only factors that were significant after multivariable analyses were within the diagnostic cohort: perceived risk of diagnostic testing (RR 0.23, 95% CI 0.10-0.54) and desire for more directive counseling regarding testing (RR 1.53, 95% CI 1.04-2.27), (Table 6).

Non-significant Correlates

Demographic factors including race, marital status, gravidity, parity, previous genetic counseling, and religious belief were not significantly correlated with any testing decision. Factors associated with coping strategy, previous experiences with genetic conditions or disabilities, personal fear of a diagnostic procedure, sufficient information about testing, feeling pressured about testing, and most social support factors (with the exception of the opinion of a partner or family member regarding diagnostic testing) were not correlated with the testing decision in either cohort.

Fetal Intervention

Of the 11 patients who were considering fetal intervention, the majority reported that: they felt genetic testing could explain the ultrasound findings (n=8), the testing would change how they managed their pregnancy (n=8), they would have wanted the medical team to be directive about the genetic testing decision (n=9), and the opinion of their partner or family was important to the genetic testing decision (n=10). All reported the information was useful to them at this time, the testing was offered in their best interest, and they would want the medical team to know if there was a genetic condition. Interestingly, three of the 11 patients who were considering fetal intervention and had diagnostic testing reported that diagnostic testing was too risky to the pregnancy.

Discussion

This study examined a broad range of demographic and psychosocial factors that potentially influence the testing decision in the presence of ultrasound anomalies known to be associated with genetic conditions. Knowledge of influential factors can improve the provision of patient-centered care that incorporates patients' experiences and goals.

Risk of Diagnostic Testing

Unsurprisingly, the risk perception of diagnostic testing had a significant impact on its acceptance. Patients were roughly four times less likely to accept diagnostic testing if they felt it was too

risky to the pregnancy (RR 0.23, 95% CI 0.10-0.54). Multiple studies affirm that the risk for miscarriage and preterm birth negatively influences the uptake or regard of diagnostic testing [2-6, 25, 26]. Conversely, a personal fear of needles or invasive procedures did not reach significance (p=.115). This speaks to the salience of the perceived risk to the pregnancy versus the perceived risks of the procedure to oneself.

Examining this more closely, studies have acknowledged the theory of planned behavior [27] and *a priori* beliefs about diagnostic testing as a primary reason for declining [25, 26, 28]. Individuals who perceive accepting diagnostic testing a priori as 'too risky' may evaluate testing negatively, thereby diminishing the impact of new information learned during genetic counseling. For example, 23% of patients in our cohort had high concern for a genetic condition yet declined diagnostic testing. If they had a negative *a priori* belief about diagnostic testing, concern for a genetic condition may not override the belief about the risk. Similarly, 26% of individuals declined diagnostic testing and felt diagnostic testing was too risky, despite reporting that the knowledge of a genetic condition would be useful.

Looking beyond the risks of diagnostic testing, it is also important to evaluate other factors that influence a testing decision. It was noted that 22% of patients did not express a desire for prenatal knowledge of a genetic condition, and 36% did not feel it would impact the medical management of the pregnancy. Despite this, 95% of patients had some form of diagnostic or screening test for a genetic condition over the course of their pregnancy. This discrepancy highlights concern for the routinization of cfDNA screening. The "non-invasive" nature of cfDNA is more likely to be perceived as "just a simple blood test". However, this may result in less informed decision making, increased psychological stress, less provider-patient rapport, and a reduced sense of autonomy [28-32]. Not every family will find value in genetic testing regardless of increased detection, more insurance coverage, or the elimination of risk. Understanding patient values, provider assumptions, and how they can conflict with each other enhances the clinician's empathy and encourages thoughtful engagement about the genetic testing decision.

Value of Knowledge and the Influence of Pregnancy Management

Patients who reported a prenatal diagnosis would be useful represented a greater proportion of those who accepted diagnostic testing (49.3%) versus those who did not (4.5%, $p<0.001$). This difference became slightly less pronounced when evaluating all testing decisions (57.8% versus 18.2% respectively, $p=0.002$). Thirty of the thirty-eight patients who accepted diagnostic testing indicated that the information would help to inform medical management of their pregnancy.

Of the patients in this study considering fetal intervention, all eleven affirmed that the information was valuable to them and eight stated that it would change the management of their pregnancy. While there are well established fetal interventions for conditions such as lower urinary tract obstructions and open neural tube defects, interventions for single-gene conditions are also being studied. Studies have examined interventions in alpha-thalassemia major [33], severe osteogenesis imperfecta [34], and neonatal lethal Gaucher's disease [35]. This study suggests that more individuals would elect genetic testing if interventions for genetic conditions were available.

Individuals with a higher level of concern for a genetic condition appeared to be more likely to accept any genetic test when examining the fetal center facilitated testing decision. Of those who had increased concern for a genetic condition, 24 had accepted diagnostic testing and 12 had accepted additional screening. Only three individuals elected diagnostic or a screening test respectively when expressing a low concern. This concern level is likely partially dependent upon the risk assessment provided during pretest counseling. For example, copy number variants are detected in 8.1% of pregnancies with ultrasound abnormalities, but the yield varies broadly based on the specific findings, such as the presence of multisystem anomalies [36]. Additionally, the yield of prenatal exome sequencing (ES) can range from 6.2% to 80% based on the indication [37]. Thus, pre-test counseling should entail an accurate risk assessment based on quality prenatal imaging, family history, and studies describing prenatal phenotypes of genetic conditions.

Knowledge of a genetic condition is believed to help families better prepare for the birth of their child. Anecdotally, many providers in the prenatal setting provide this advanced preparation as a rationale for testing. In our cohort, this was echoed by 63% of participants who reported that genetic testing could impact medical management of the pregnancy and 75% who responded that the knowledge of a genetic condition could be useful during the prenatal period. Michie [38], highlighted three possible domains of preparation: clinical activities (such as fetal intervention), social and informational support, and psychological preparation. Preparation can be a unique to each family. Coping mechanisms were evaluated to elucidate whether "problem solvers", "social support seekers", or "avoiders", made different testing decisions, but we did not observe any significant differences that would help inform pre-test discussions. Additional studies are needed to understand how to tailor information that will better prepare families after diagnosis of fetal anomalies.

Limitations of Screening

It is important to consider that 40% of the patients that felt testing could explain the ultrasound finding underwent screening rather than diagnostic testing. While the vast majority of patients (95%) reported they understood the testing options, ensuring that patients know the limitations of screening is important. In a study by Wittman and others, there was concern that some patients misinterpreted negative screen results as definitively negative [39]. Additionally, there is evidence of increased use of cfDNA screening in the presence of ultrasound anomalies [40]. Regardless of advancements in screening, diagnostic CMA remains the recommended first line test in the presence of a fetal anomalies [12]. Further investigation of how patients perceive limitations of screening after discovery of an ultrasound anomaly may be warranted.

The Effect of the Medical Team

A few patients felt that either: 'testing was *not* being offered in their best interest' (7%) or felt they '*would not* want the medical team to know if there was a genetic condition' (11%). These patients all declined diagnostic testing and only one accepted screening. However, individuals who reported not

trusting the motives of those offering the testing largely stated they would want their medical team to know if there was a genetic condition. This study was unable to resolve the incongruity of these responses. Further studies of trust in the medical team in the prenatal setting should be pursued in order to elucidate the specific nature of mistrust. Building trust with patients and facilitating healthcare decisions collaboratively helps empower patients not only during their pregnancy but also can influence future healthcare decisions for the child and in future pregnancies [41].

Mistrust can be fostered by a number of factors. Examples of medical mistrust have been associated with race and socioeconomic status [42], fatalism [43], experiential decision making [32, 44, 45] and routinization of prenatal screening [3, 31, 32]. In our study, race was not a significant factor in the testing decision. In looking at educational attainment, a greater proportion of individuals with high school education or less (23% versus 5%) stated that they would not want the medical team to know if there was a genetic condition. Therefore, it appeared that mistrust tracked in our cohort with lower educational attainment rather than race/ethnicity.

Interestingly, wanting the medical team to be more directive in the testing decision was reported by 42% of patients. This remained significant after multivariable analysis. Patients who wanted the testing recommendation of the medical team were more likely to have diagnostic testing (RR 1.52, CI 95% 1.02-2.27). This may represent trust, rapport, and confidence in the care team, but may also be influenced by stress and uncertainty in the context of fetal anomalies. Future studies may wish to explore further why many patients with fetal anomalies want more directive counseling.

Strengths and Limitations of the Study

This study examined decision-making in the context of a fetal ultrasound anomaly at a tertiary referral center that serves a racially and socially diverse population. Therefore, a major strength of this study was the ability to assess for attitudes of individuals of more diverse backgrounds. With the exception of those who had accepted testing for fetal intervention, the facilitated testing decision group elected or declined testing at the time of the survey, removing hypothetical decision making relied on in

other studies. Additionally, the genetic counseling unit is staffed by a small, experienced team which limits variability in how pre-test counseling is provided.

The small sample size limited the ability to resolve factors with smaller effect sizes, limiting our comparison groups. Additionally, resolution of the data was lost by compressing survey categories. Another limitation was the inability to capture decision making that happened prior to arrival at the fetal center, as was the case for many individuals who had aneuploidy screening before arriving at the fetal center. Lastly, while the coping strategy survey was validated [23], the survey utilized to assess decision-making factors was not.

Future Directions

Additional research is needed to explore how families utilize the information gained through genetic testing, particularly as genetic information becomes increasingly accessible through cfDNA screening. Our study demonstrates the need for more research regarding trust and perception of the care team and how they will use prenatal genetic testing results. Lastly, expanding the survey cohort may further refine the impact and relative weight of some of the factors that have been explored in this research.

Conclusion

This study highlights the impact of perceived risk on the uptake of genetic testing in a high-risk setting and emphasizes how decision-making factors may be complex and unique to individual patients. How providers communicate the value of testing and what can be done with this information will be critical, particularly as testing expands in breadth and depth. Additionally, it is important to explain the limitations of cfDNA screening given the majority of patients in this study declined diagnostic testing despite having an increased risk for a genetic condition. Lastly, trust in the medical team is critical to consider both in the impact on testing uptake and the overall care of these high-risk pregnancies. In the rapidly evolving landscape of genetic testing, understanding these individual factors, building trust and rapport with patients, and tailoring the counseling to patients' needs are essential.

Appendix

Appendix A – Four-Point Likert Tables

***Table 7a*- Diagnostic Testing Decision and Decision-Making Factors (Four-Point Likert)**

	Total (n=99)	%	Yes (n=38)	%	No (n=61)	%	p-value
Rate your level of concern for a genetic condition							0.315
None	10	10.1	3	7.9	7	11.5	
Minimal	25	25.3	7	18.4	18	29.5	
Some	26	26.3	9	23.7	17	27.9	
A great deal	38	38.4	19	50.0	19	31.1	
Describe your experience or amount of interaction with individuals with special needs, physical or intellectual disabilities or genetic conditions							0.056
None	20	20.2	4	10.5	16	26.2	
Minimal	37	37.4	18	47.4	19	31.1	
Some	23	23.2	6	15.8	17	27.9	
A great deal	19	19.2	10	26.3	9	14.8	
I feel that invasive testing (amniocentesis or CVS) is too risky to the pregnancy							**<.001**
Strongly Agree	18	18.2	1	2.6	17	27.9	
Agree	30	30.3	4	10.5	26	42.6	
Disagree	44	44.4	31	81.6	13	21.3	
Strongly Disagree	3	3.0	1	2.6	2	3.3	
Unknown	4	4.0	1	2.6	3	4.9	
I have a fear of needles and/or invasive procedures							0.241
Strongly Agree	14	14.1	6	15.8	8	13.1	
Agree	35	35.4	9	23.7	26	42.6	
Disagree	28	28.3	14	36.8	14	23.0	
Strongly Disagree	22	22.2	9	23.7	13	21.3	
I feel that genetic testing could explain what caused the ultrasound finding in my pregnancy							**0.021**
Strongly Agree	23	23.2	14	36.8	9	14.8	
Agree	53	53.5	20	52.6	33	54.1	
Disagree	20	20.2	4	10.5	16	26.2	
Strongly Disagree	3	3.0	0	0.0	3	4.9	
I feel that I understood the genetic testing options and was able to make an informed choice							0.305
Strongly Agree	46	46.5	21	55.3	25	41.0	
Agree	49	49.5	17	44.7	32	52.5	
Disagree	3	3.0	0	0.0	3	4.9	
Strongly Disagree	1	1.0	0	0.0	1	1.6	
If there was a genetic condition, I would like to know about it before delivery							**<.001**
Strongly Agree	40	40.4	24	63.2	16	26.2	
Agree	35	35.4	13	34.2	22	36.1	
Disagree	22	22.2	1	2.6	21	34.4	
Strongly Disagree	0	0.0	0	0.0	0	0.0	
Unknown	2	2.0	0	0.0	2	3.3	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)

***Table 7b*- Diagnostic Testing Decision and Decision-Making Factors (Four-Point Likert)**

	Total (n=99)	%	Yes (n=38)	%	No (n=61)	%	
The opinion of my partner or family member is important in helping me decide whether to have genetic testing							**0.049**
Strongly Agree	44	44.4	21	55.3	23	37.7	
Agree	37	37.4	15	39.5	22	36.1	
Disagree	16	16.2	2	5.3	14	23.0	
Strongly Disagree	2	2.0	0	0.0	2	3.3	
The opinion of a friend is important in helping me decide whether to have genetic testing							**0.03**
Strongly Agree	1	1.0	0	0.0	1	1.6	
Agree	18	18.2	8	21.1	10	16.4	
Disagree	59	59.6	27	71.1	32	52.5	
Strongly Disagree	21	21.2	3	7.9	18	29.5	
My religious faith influenced my genetic testing decision							0.200
Strongly Agree	9	9.1	6	15.8	3	4.9	
Agree	14	14.1	3	7.9	11	18.0	
Disagree	48	48.5	19	50.0	29	47.5	
Strongly Disagree	28	28.3	10	26.3	18	29.5	
My belief in the spiritual influenced my genetic testing decision							0.176
Strongly Agree	7	7.1	4	10.5	3	4.9	
Agree	16	16.2	4	10.5	12	19.7	
Disagree	46	46.5	22	57.9	24	39.3	
Strongly Disagree	29	29.3	8	21.1	21	34.4	
Unknown	1	1.0	0	0.0	1	1.6	
Genetic testing would conflict with my faith							0.248
Strongly Agree	0	0.0	0	0.0	0	0.0	
Agree	4	4.0	0	0.0	4	6.6	
Disagree	54	54.5	22	57.9	32	52.5	
Strongly Disagree	40	40.4	15	39.5	25	41.0	
Unknown	1	1.0	1	2.6	0	0.0	
I believe that genetic testing is being offered in my best interest							**0.003**
Strongly Agree	35	35.4	20	52.6	15	24.6	
Agree	57	57.6	17	44.7	40	65.6	
Disagree	6	6.1	0	0.0	6	9.8	
Strongly Disagree	0	0.0	0	0.0	0	0.0	
Unknown	1	1.0	1	2.6	0	0.0	
I would want my medical team to know if there was a genetic condition before delivery							**<.001**
Strongly Agree	40	40.4	25	65.8	15	24.6	
Agree	49	49.5	13	34.2	36	59.0	
Disagree	10	10.1	0	0.0	10	16.4	
Strongly Disagree	0	0.0	0	0.0	0	0.0	
If there was a genetic condition, it would change the way I medically manage my pregnancy							**0.021**
Strongly Agree	22	22.2	14	36.8	8	13.1	
Agree	41	41.4	16	42.1	25	41.0	
Disagree	26	26.3	6	15.8	20	32.8	
Strongly Disagree	10	10.1	2	5.3	8	13.1	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)

***Table 7c*- Diagnostic Testing Decision and Decision-Making Factors (Four-Point Likert)**

	Total (n=99)	%	Yes (n=38)	%	No (n=61)	%	
If there was a genetic condition, it would change the way I feel about my pregnancy							0.188
Strongly Agree	9	9.1	4	10.5	5	8.2	
Agree	19	19.2	9	23.7	10	16.4	
Disagree	46	46.5	19	50.0	27	44.3	
Strongly Disagree	24	24.2	5	13.2	19	31.1	
Unknown	1	1.0	1	2.6	0	0.0	
I did not feel pressured to undergo genetic testing							0.862
Strongly Agree	45	45.5	19	50.0	26	42.6	
Agree	46	46.5	16	42.1	30	49.2	
Disagree	6	6.1	2	5.3	4	6.6	
Strongly Disagree	2	2.0	1	2.6	1	1.6	
I feel that I had adequate input from the medical team in making a decision about genetic testing							0.451
Strongly Agree	45	45.5	20	52.6	25	41.0	
Agree	53	53.5	18	47.4	35	57.4	
Disagree	1	1.0	0	0.0	1	1.6	
Strongly Disagree	0	0.0	0	0.0	0	0.0	
I feel that I had adequate input from family and friends in making a decision about genetic testing							0.180
Strongly Agree	28	28.3	12	31.6	16	26.2	
Agree	50	50.5	20	52.6	30	49.2	
Disagree	18	18.2	4	10.5	14	23.0	
Strongly Disagree	2	2.0	2	5.3	0	0.0	
Unknown	1	1.0	0	0.0	1	1.6	
I would have liked the genetic counselor or doctor to tell me if I should get genetic testing or not							0.224
Strongly Agree	9	9.1	4	10.5	5	8.2	
Agree	33	33.3	17	44.7	16	26.2	
Disagree	49	49.5	15	39.5	34	55.7	
Strongly Disagree	8	8.1	2	5.3	6	9.8	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)

***Table 8a*- Facilitated Testing Decision and Decision-Making Factors (Four-Point Likert)**

	Total (n=88)	%	Yes (n=42)	%	No (n=46)	%	p-value
Rate your level of concern for a genetic condition							**<.001**
None	9	10.2	4	9.5	5	10.9	
Minimal	19	21.6	2	4.8	17	37.0	
Some	25	28.4	13	31.0	12	26.1	
A great deal	35	39.8	23	54.8	12	26.1	
Describe your experience or amount of interaction with individuals with special needs, physical or intellectual disabilities or genetic conditions							0.15
None	19	21.6	5	11.9	14	30.4	
Minimal	33	37.5	19	45.2	14	30.4	
Some	22	25.0	10	23.8	12	26.1	
A great deal	14	15.9	8	19.0	6	13.0	
I feel that invasive testing (amniocentesis or CVS) is too risky to the pregnancy							**<.001**
Strongly Agree	17	19.3	5	11.9	12	26.1	
Agree	28	31.8	8	19.0	20	43.5	
Disagree	36	40.9	26	61.9	10	21.7	
Strongly Disagree	3	3.4	2	4.8	1	2.2	
Unknown	4	4.5	1	2.4	3	6.5	
I have a fear of needles and/or invasive procedures							**0.049**
Strongly Agree	12	13.6	8	19.0	4	8.7	
Agree	32	36.4	10	23.8	22	47.8	
Disagree	26	29.5	12	28.6	14	30.4	
Strongly Disagree	18	20.5	12	28.6	6	13.0	
I feel that genetic testing could explain what caused the ultrasound finding in my pregnancy							**<.001**
Strongly Agree	21	23.9	15	35.7	6	13.0	
Agree	47	53.4	26	61.9	21	45.7	
Disagree	17	19.3	1	2.4	16	34.8	
Strongly Disagree	3	3.4	0	0.0	3	6.5	
I feel that I understood the genetic testing options and was able to make an informed choice							0.154
Strongly Agree	41	46.6	23	54.8	18	39.1	
Agree	43	48.9	19	45.2	24	52.2	
Disagree	3	3.4	0	0.0	3	6.5	
Strongly Disagree	1	1.1	0	0.0	1	2.2	
If there was a genetic condition, I would like to know about it before delivery							**<.001**
Strongly Agree	36	40.9	27	64.3	9	19.6	
Agree	28	31.8	10	23.8	18	39.1	
Disagree	22	25.0	4	9.5	18	39.1	
Strongly Disagree	0	0.0	0	0.0	0	0.0	
Unknown	2	2.3	1	2.4	1	2.2	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)

***Table 8b*- Facilitated Testing Decision and Decision-Making Factors (Four-Point Likert)**

	Total (n=88)	%	Yes (n=42)	%	No (n=46)	%	p-value
The opinion of my partner or family member is important in helping me decide whether to have genetic testing							0.189
Strongly Agree	40	45.5	23	54.8	17	37.0	
Agree	31	35.2	14	33.3	17	37.0	
Disagree	15	17.0	4	9.5	11	23.9	
Strongly Disagree	2	2.3	1	2.4	1	2.2	
The opinion of a friend is important in helping me decide whether to have genetic testing							0.977
Strongly Agree	1	1.1	0	0.0	1	2.2	
Agree	16	18.2	8	19.0	8	17.4	
Disagree	51	58.0	25	59.5	26	56.5	
Strongly Disagree	20	22.7	9	21.4	11	23.9	
My religious faith influenced my genetic testing decision							0.196
Strongly Agree	9	10.2	7	16.7	2	4.3	
Agree	13	14.8	4	9.5	9	19.6	
Disagree	42	47.7	19	45.2	23	50.0	
Strongly Disagree	24	27.3	12	28.6	12	26.1	
My belief in the spiritual influenced my genetic testing decision							0.377
Strongly Agree	7	8.0	5	11.9	2	4.3	
Agree	15	17.0	5	11.9	10	21.7	
Disagree	40	45.5	21	50.0	19	41.3	
Strongly Disagree	25	28.4	11	26.2	14	30.4	
Unknown	1	1.1	0	0.0	1	2.2	
Genetic testing would conflict with my faith							0.159
Strongly Agree	0	0.0	0	0.0	0	0.0	
Agree	4	4.5	0	0.0	4	8.7	
Disagree	47	53.4	22	52.4	25	54.3	
Strongly Disagree	36	40.9	19	45.2	17	37.0	
Unknown	1	1.1	1	2.4	0	0.0	
I believe that genetic testing is being offered in my best interest							**<.001**
Strongly Agree	21	23.9	21	50.0	9	19.6	
Agree	20	22.7	20	47.6	31	67.4	
Disagree	6	6.8	0	0.0	6	13.0	
Strongly Disagree	0	0.0	0	0.0	0	0.0	
Unknown	1	1.1	1	2.4	0	0.0	
I would want my medical team to know if there was a genetic condition before delivery							**<.001**
Strongly Agree	33	37.5	25	59.5	8	17.4	
Agree	45	51.1	16	38.1	29	63.0	
Disagree	10	11.4	1	2.4	9	19.6	
Strongly Disagree	0	0.0	0	0.0	0	0.0	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)

***Table 8c*- Facilitated Testing Decision and Decision-Making Factors (Four-Point Likert)**

	Total (n=88)	%	Yes (n=42)	%	No (n=46)	%	p-value
If there was a genetic condition, it would change the way I medically manage my pregnancy							**0.008**
Strongly Agree	19	21.6	15	35.7	4	8.7	
Agree	36	40.9	17	40.5	19	41.3	
Disagree	24	27.3	7	16.7	17	37.0	
Strongly Disagree	9	10.2	3	7.1	6	13.0	
If there was a genetic condition, it would change the way I feel about my pregnancy							0.863
Strongly Agree	9	10.2	4	9.5	5	10.9	
Agree	18	20.5	10	23.8	8	17.4	
Disagree	39	44.3	17	40.5	22	47.8	
Strongly Disagree	22	25.0	11	26.2	11	23.9	
I did not feel pressured to undergo genetic testing							0.288
Strongly Agree	41	46.6	21	50.0	20	43.5	
Agree	40	45.5	18	42.9	22	47.8	
Disagree	5	5.7	1	2.4	4	8.7	
Strongly Disagree	2	2.3	2	4.8	0	0.0	
I feel that I had adequate input from the medical team in making a decision about genetic testing							0.133
Strongly Agree	40	45.5	23	54.8	17	37.0	
Agree	47	53.4	19	45.2	28	60.9	
Disagree	1	1.1	0	0.0	1	2.2	
Strongly Disagree	0	0.0	0	0.0	0	0.0	
I feel that I had adequate input from family and friends in making a decision about genetic testing							0.448
Strongly Agree	25	28.4	13	31.0	12	26.1	
Agree	45	51.1	19	45.2	26	56.5	
Disagree	15	17.0	7	16.7	8	17.4	
Strongly Disagree	12	13.6	2	4.8	0	0.0	
Unknown	1	1.1	1	2.4	0	0.0	
I would have liked the genetic counselor or doctor to tell me if I should get genetic testing or not							0.168
Strongly Agree	8	9.1	4	9.5	4	8.7	
Agree	25	28.4	15	35.7	10	21.7	
Disagree	48	54.5	18	42.9	30	65.2	
Strongly Disagree	7	8.0	5	11.9	2	4.3	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)

Appendix B – Coping Strategy Results

Table 9 **- Coping Strategy Indicator and Testing Decision**

	Diagnostic				FTD			
	Total (n=99)	**Yes (n=38)**	**No (n=61)**	**p-value**	**Total (n=88)**	**Yes (n=42)**	**No (n=46)**	**p-value**
Problem Solving*				0.55				0.47
Low	2	1	1		2	1	1	
Average	56	23	32		45	22	23	
High	38	14	25		38	19	19	
Unknown	3	0	3		3	0	3	
Social Support Seeking				0.053				0.83
Very Low	1	0	1		1	1	0	
Low	12	1	11		12	5	7	
Average	51	25	26		43	21	22	
High	30	11	19		28	14	14	
Unknown	5	1	4		4	1	3	
Avoidant				0.48				0.17
Low	12	3	9		9	2	7	
Average	49	22	27		44	24	20	
High	22	6	16		21	7	14	
Very High	10	5	5		9	6	3	
Unknown	6	2	4		5	3	2	

p-values calculated using a χ^2 or Fisher's exact test (bolded significant at $p<0.05$)
*No respondents had a rating of 'very low' in problem solving

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