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What Influences the Willingness of Blacks and African Americans to Enroll in Preclinical Alzheimer's Disease Biomarker Research? A Qualitative Vignette Analysis

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Abstract.
Background: Alzheimer's disease (AD) begins with an asymptomatic "preclinical" phase, in which abnormal biomarkers indicate risk for developing cognitive impairment. Research is increasingly focused on validating biomarkers to improve reliable diagnosis and timely clinical treatment of AD. Most preclinical biomarker research lacks adequate representation of Black/African American and other racially and ethnically minoritized individuals, limiting the applicability of data to these groups. This may exacerbate existing disparities by hindering diagnosis and treatment among racially and ethnically minoritized individuals.
Objective: Understand the factors influencing willingness of Blacks/African Americans to participate in AD biomarker research and identify opportunities to improve enrollment.
Methods: We enrolled Blacks/African Americans ($N = 145$) between 46–85 years of age who had previously participated in AD research. Participants gave open-ended responses to a vignette describing a hypothetical biomarker research study. Using qualitative content analysis, we identified themes that motivated and discouraged enrollment in AD biomarker research.
Results: Participant responses were categorized into several themes. Themes motivating participation included a desire to know their biomarker results and to support research. Major themes discouraging participation included concerns about potential negative psychological outcomes to learning one's increased risk for AD, doubt about the usefulness of testing, and worry about the potential physical harms of testing.

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Conclusion: Understanding themes motivating and discouraging AD preclinical biomarker research participation may inform research material development, approach to community engagement, and/or trial design to increase enrollment of Blacks/African Americans.

Keywords: African Americans, Alzheimer's disease, biomarkers, qualitative research

INTRODUCTION

Alzheimer's disease (AD) is a progressive neurodegenerative condition leading to cognitive impairment and is typically diagnosed with the onset of cognitive symptoms and functional decline [1, 2]. Yet, growing evidence demonstrates that pathophysiological changes underlying AD can be detected by biomarkers in a "preclinical" phase before symptoms appear [3]. Biomarkers for AD are becoming increasingly important as diagnostic and prognostic tools. Establishing validated and prognostically useful biomarker tests is critical to identify treatment populations and improve diagnosis of symptomatic cognitive impairment due to AD [4]. Preclinical AD biomarkers can be used to identify appropriate clinical trial cohorts or to detect AD in the stages of the disease when intervention may be more effective [5]. The US Food and Drug Administration (FDA) has recently approved the first disease-modifying treatment for AD on the basis of its reduction of amyloid plaques [6]. In the future individuals with late onset AD, which accounts for over 90% of AD cases [7], will likely need biomarker evidence of AD to obtain treatment [8].

Most biomarker research to date has been conducted in White, non-Hispanic samples [9,10], as has most biomedical research overall. Despite over 30% of the US population being members of racial and ethnically underrepresented groups, these individuals only make up around 17% of participants in clinical trials [11]. Data from clinical and genetic research in international cohorts shows a similar lack of diversity [12, 13]. The significant need for more inclusive research across diseases has been recognized, such as in large-scale research on the intersection of genetics and lifestyle [14]. Specifically in AD research, a recent systematic review demonstrated that a median of 89% of participants of those studies reporting race and ethnicity were White [15]. There is a great need for more inclusive research. Incidence and prevalence of AD and other dementias is higher among Black/African American and other underrepresented groups, with some estimates suggesting twice as much AD risk among Blacks/African Americans when compared to Whites [16]. Blacks/African Americans face a number of disparities in dementia care, as they tend to be diagnosed in later stages of the disease and use fewer services, resulting in higher care and financial burdens for families [17, 18].

The limited inclusiveness of biomarker study samples raises concerns about the validity and reliability of biomarker data in underrepresented groups [19]. Data shows that biomarker changes in AD can vary between Black/African American and White populations, and similar biomarker profiles can be associated with divergent cognitive function [20, 21]. The current lack of reliable biomarker data for underrepresented groups limits the diagnostic, prognostic, and therapeutic validity of biomarkers for clinical use in these populations, and has the potential to further exacerbate health disparities [9].

The data that exists about attitudes towards AD biomarker research shows that interest is generally high among those who consider themselves to be at risk for AD or are already involved in AD research [22, 23]. However, the decision to enroll in a biomarker research study is complex [24]. Little is known about how individuals weigh factors like personal AD risk or procedure invasiveness when deciding to participate in research. In an analysis of interest in a preclinical AD trial, participants were just as willing to join a study where they learned their biomarker results as one in which they did not, indicating reasons other than learning amyloid results may drive actual participation [25]. Other reasons influencing participants may include the invasiveness of procedures involved [26], or an altruistic desire to contribute to research [27].

Prior studies on recruitment and retention in AD research have indicated the importance of aspects such as trust in researchers, study burdens, socioeconomic context, personal attitudes, and levels of education [11, 28]. However, these studies have focused on participation in clinical trials rather than biomarker studies [29, 30]. Research has typically compared Black/African American and White populations, and focused less on a comprehensive account of Black/African American perspectives.

This approach may characterize the perspective of specific groups with respect to similarity or difference to the perspectives of Whites, and potentially reduces the ability to explore the breadth of perspectives within that specific group. One survey study evaluating willingness to participate in a biomarker-based clinical trial showed that Blacks/African Americans were generally less likely to enroll, and rated study risks and procedures as being more important to their decision than Whites. Blacks/African Americans were also somewhat less interested in receiving their personal study results than White participants [29]. A survey in a community-based registry suggested that underrepresented groups, including Blacks/African Americans, were less willing to enroll in AD studies than Whites [30]. In a qualitative study among community-dwelling Blacks/African Americans, mistrust of research was the major barrier to participation in biomarker research [31]. Though mistrust limits the involvement of Blacks/African Americans in research, enrollment in dementia research can be increased with comprehensive and community focused recruitment strategies [32]. Altruism is also an important factor motivating ongoing research participation [28], but it is unknown how altruism impacts participation in biomarker studies, or what strategies might improve enrollment specifically for this research.

This study aims to understand factors influencing cognitively intact Blacks'/African Americans' willingness to participate in preclinical AD biomarker research. We present data from the Alzheimer's Biomarker Survey, a telephone survey designed to gather quantitative and qualitative data on willingness to enroll in hypothetical biomarker studies. Here, we report qualitative information with the goal of understanding the relative significance of different themes in influencing willingness to enroll. Our sample consists of individuals who are already involved in AD research and have high levels of education, and is thus not broadly representative [33]. Research must ultimately become more inclusive, enrolling Blacks/African Americans not involved in research and with diverse educational backgrounds. Given the dearth of available data about Black/African American participation in biomarker research, this study contributes to understanding the factors involved in decision-making, which can ideally be leveraged to increase participation of those Blacks/African Americans already involved in research, and spur further research moving towards more inclusive research outside of those populations typically represented in AD cohorts. Representative research will ultimately be necessary to reduce disparities in AD-biomarker research as well as clinical interventions. Given that treatment with amyloid targeting drugs will require biomarker evidence of AD pathology, furthering biomarkers that can accurately diagnose AD in diverse populations can also move the field further towards equitable care for AD.

METHODS

Participants

Participants were recruited into the Alzheimer's Biomarker Survey from the Wisconsin Registry for Alzheimer's Prevention (WRAP) [34], or the Wisconsin Alzheimer's Disease Research Center Clinical Core (Wisconsin ADRC). Participants had median number of three cohort study visits before participating in the Biomarker Survey. Biomarker Survey participants were required to be aged 45–89 and cognitively unimpaired. As participants could select multiple racial identities, all participants selecting Black as a self-identification were categorized as Black, even when more than one identity was selected. Our analysis includes only those participants who self-identified as Black/African American; quantitative predictors of willingness to enroll for the full cohort are reported elsewhere [35]. All participants provided institutionally approved informed consent before participation.

The final sample included 145 Black/African American participants (mean age = 64.9), most of whom (74%) were women. Many had a bachelor's degree or higher (45%) and about half had a family history of dementia (52.4%). Table 1 shows participant characteristics.

Survey

The Alzheimer's Biomarker Survey is a 30-minute telephone survey developed by the study team using

Table 1
Participant characteristics

Number of participants	145
Age, mean (range)	65 (46-85)
Gender,	
Number of women (%)	107 (74%)
Number of men (%)	38 (26%)
Education, $N \geq$ bachelor's degree (%)	65 (45%)
Family history of dementia, N (%)	76 (52%)

Table 2
Survey vignette

Vignette	I'm going to ask you some questions about participating in specific Alzheimer's research studies. There are lots of reasons why a person may not want to be in a research study such as how long the study takes or how far it is from a person's home. For this survey, we would like you to try to ignore those reasons and focus on if these studies generally sound like something you would participate in. Let's say you are asked to join a study that would measure a marker in your brain that shows if you are at a higher risk of developing Alzheimer's. The brain marker does not show if you currently have Alzheimer's or predict if you actually will develop Alzheimer's in the future. Although in this study you would learn your results, there are currently no medications to cure Alzheimer's or to reduce your brain marker. How willing would you be to enroll in this study?
Response options	(1) Not at all willing (2) A little willing (3) Somewhat willing (4) Very willing (5) Extremely willing
Open-ended follow-up	(a) Tell me why you would be [insert previous response: not at all/a little/somewhat/very/extremely] willing to enroll in a study that measured your brain marker? (b) What concerns would you have about enrolling in this study?

feedback from the University of Wisconsin Survey Center (UWSC) in an iterative process. Several drafts were reviewed by the study team, UWSC, and external content expert consultants. To assess willingness to enroll in biomarker studies, we developed a vignette describing a hypothetical AD biomarker study. The vignette describes the biomarker collection method in non-technical terms but without specifying a particular method. After the vignette, participants were asked to rank their willingness to enroll in the study on a five-point Likert scale. This was followed by two open-ended questions asking participants to describe why they chose their response and their concerns about the study. The vignette and questions are described in Table 2.

Data collection and analysis

Data were collected from January 2020 through March 2020. The survey was conducted using a computer-assisted telephone interviewing system (CATI). The CATI software employed by the UWSC is CASES 5.6 provided by the Computer-Assisted Survey Methods Program at the University of California-Berkeley.

Data were analyzed using qualitative content analysis [36]. Qualitative data were first coded by UWSC coders, who used inductive coding as the initial coding method (see Coding Manual for Qualitative Researchers [37]), using NVivo (version 12). Themes were generated from initial coding of responses themselves rather than defined *a priori*. Responses could be coded with multiple themes. This process continued until saturation was reached, and no new themes were identified from the interviews. A coding framework was then created by two UWSC coders, and discrepancies between coders were resolved through discussion with members of the research team. Using that coding framework, transcripts were reviewed again, further refining coding categories to identify major themes. To establish trustworthiness in analysis [38], both initial coding categories and further refinements of categories were reviewed with several members of the team, and questions regarding coding categories were resolved in discussion, while noting any potential bias among researchers. Team members were chosen based on their expertise with qualitative research and/or AD disclosure research.

In a second step we applied mixed-methods to link each participant's qualitative response to their willingness to enroll in AD biomarker research Likert-scale response. The frequency of each thematic response was then calculated for each of the five possible willingness to enroll in biomarker research Likert-scale responses (which ranged from "not at all willing" to "extremely willing" to enroll).

RESULTS

Participants described several themes that influenced their willingness to participate in biomarker research. The first section presents themes motivating participation, and the second, themes discouraging participation. An overview of themes and how frequently they were mentioned by participants is shown in Table 3. The third section examines the relationship

Table 3
Frequency of themes influencing willingness to enroll in biomarker research among all participants

Themes motivating willingness to enroll	Number (%)
Desire to know	72 (50%)
Support for research	52 (36%)
Themes discouraging willingness to enroll	
Physical harms of testing	48 (33%)
Anxiety	24 (17%)
Questionable utility of testing	19 (13%)
Burden of testing	18 (12%)
Stigma around result	17 (12%)

between the themes and willingness to participate in biomarker research.

Themes motivating participation

Desire to know biomarker results

A major theme motivating interest in enrolling in biomarker research was participants' desire to learn their biomarker results. They cited several specific reasons underlying this desire. Many cited a wish to know their personal risk for developing AD:

> It would give me a sense of where I am, whether I'm headed in that direction, or whether I'm at the point where you don't see anything that would cause a mental change in my brain or behavior. And I'd want to know that. (Participant 008)

Family history of AD was often mentioned, which could increase anxiety and motivate interest in knowing one's risk for dementia:

> Because in the future there's a chance I might get it because of my family's genetics . . . It's just something I wish I could prevent having because it is scary for me right now. (Participant 242)

This knowledge could in turn be useful, to modify their risk through treatment and potentially treat dementia:

> I would want to know if I have a large percentage [risk] of getting Alzheimer's then maybe they can catch it early. Even though there is no cure, there could be something they can do to slow its progress. (Participant 189)

For others, their primary motivation in learning their risk status was to prepare themselves and their families for the possibility of future cognitive decline:

> I just think it would be good to know be able to plan the future to be able to do the things you want to do before you are unable to do them. And I think to be able to communicate that to your family. (Participant 156)

Altruism and support for research

A second major theme was the desire to support research, which encompassed a number of aspects related to altruism. Many individuals generally supported dementia research:

> I believe that research is always going to be the cure to any problem. If people did not participate there would be no cures. (Participant 093)

Some were motivated by personal experiences with dementia, and research was a way to help family members as well as others in their community:

> I feel that, with seeing my mother suffer, and others that I love and am close to, suffer from Alzheimer's, it's worth it to try and help. I would be helping to stop suffering of so many people, even in my immediate family. I do take Alzheimer's research seriously. (Participant 046)

Specific motivations to join research related to being Black/African American, or concerns regarding trust in researchers were not generally mentioned, though very occasionally participants mentioned they "trusted" the researchers, which made participation easier. A small number ($n = 5$) were motivated to enroll in biomarker research to increase the diversity of research:

> I think it's important for more studies to involve people of color, so we can better understand what medicine and care is needed for those underserved populations. Most medicine is for the dominant population, and so there's not as much for people of color. (Participant 185)

This could also take the form of setting an example for others in their community:

> Because I just think it's a very good idea and me being African American woman of almost 74 years. And there are just so many Afro-Americans who are afraid of research because of things that happened years before, so they just don't get involved with it. (Participant 142)

Themes discouraging participation

Potential harms

Participants mentioned a number of concerns about enrolling in biomarker research. The first significant theme was the most common, relating to possible negative physical consequences of an abnormal biomarker test. The vignette did not specify the kind of intervention that would be performed, leaving individuals to freely express their concerns about potential harms. Almost all participants who mentioned harms indicated some type of worry about the invasiveness of tests.

> Anything that has to place something in my head or whatever, I wouldn't want to participate in. I just have concerns about anything that is being placed in, you know some type of incision. (Participant 386)

Lumbar punctures were frequently mentioned specifically as discouraging interest, even among those who otherwise supported research:

> I strongly look forward to getting involved in the research . . . The only concern I would have is I'm a little leery of the lumbar punctures that you have to do in this study. (Participant 008)

Potential for negative psychological outcomes

A second significant theme was about possible negative psychological consequences of an abnormal biomarker test. Some wanted to avoid worrying in anticipation that they would develop dementia:

> I would not want to know if I'm at a high risk. I would rather wait to find out if I had Alzheimer's, rather than worry about it. (Participant 083)

Others felt that a positive result could have profound implications, leading to hopelessness and despair:

> The major concern is if you had markers and there's no cure you would be looking at the end of your useful life. (Participant 284)

The expectation that memory problems would develop could also reinforce individuals' concerns about their cognition, since testing could uncover signs of decline:

> I want to know but I'm frightened of the response, that it might be affirmation that there's something going on . . . for example if you ask me a bunch of questions and I can only remember two or three I know from that that something is changing in my memory, it's frightening. (Participant 387)

Limited personal utility of biomarker testing

A third major theme discouraging participation was worry the utility of biomarker testing. Participants felt that if biomarkers could not definitely predict dementia, this information would not be helpful to them, and there would be no personal benefit to the study.

> Well you said, it couldn't measure your brain marker, that's what you said...If it could actually tell me, yeah, I would do it, but if you can't tell me, then no I wouldn't. (Participant 146)

In addition to ambiguity about results, the lack of effective treatment for AD cast doubt on the utility of knowing:

> What good is the information if there's no cure for it? (Participant 159)

Potential for stigma and discrimination

A fourth, less prominent theme encompassed possible negative consequences of a positive biomarker result, including discrimination or stigma (i.e., the negative beliefs and attitudes that shape how individuals with AD are viewed). Participants worried that information would not stay private, even preferring it not be in their chart:

> How would it affect my health care? is it going to be put in [my] chart where health care providers might see it? (Participant 204)

Participants were also concerned that a positive result would affect their health insurance or work:

> [My concern is] confidentiality of collected data and to ensure that data would not be used for employment or health insurance discrimination. (Participant 270)

Research burdens

A fifth theme occasionally mentioned was concern about the burdens testing would impose. Considerations like distance to the study site and the time commitment involved also influenced willingness to participate:

> I do personally have to think about how far I'd have to travel and other physical conditions about the situation and the time it would consume. (Participant 228)

Table 4
Relationship between themes and willingness to enroll in biomarker research

	Willingness to participate in biomarker research				
	Not at all	A little	Somewhat	Very	Extremely
Themes motivating willingness to enroll	% (number / total number of respondents)				
Desire to know	0% (0/10)	50% (7/14)	46% (27/59)	64% (25/39)	57% (13/23)
Support for research	0% (0/10)	14% (2/14)	24% (14/59)	54% (21/39)	65% (15/23)
Themes discouraging willingness to enroll	% (number / total number of respondents)				
Physical harms of testing	60% (6/10)	36% (5/14)	34% (20/59)	31% (12/39)	22% (5/23)
Anxiety	30% (3/10)	43% (6/14)	17% (10/59)	10% (4/39)	4% (1/23)
Questionable utility of testing	30% (3/10)	36% (5/14)	15% (9/59)	5% (2/39)	0% (0/23)
Burden of testing	10% (1/10)	7% (1/14)	12% (7/59)	13% (5/39)	17% (4/23)
Stigma around result	0% (0/10)	7% (1/14)	12% (7/59)	21% (8/39)	4% (1/23)

Willingness to participate in biomarker research was assessed by Likert-scale response. For each response, the table shows the percentage of respondents who mentioned a particular theme.

0-10% 11-20% 21-30% 31-40% 41-50% >51%

Relationship between themes and stated willingness to enroll in biomarker research

To explore relationships between themes and willingness to enroll, each participant's qualitative response was linked to their Likert-scale responses about their willingness to enroll in AD biomarker research (Table 4). Frequencies of thematic responses are tabulated by Likert-scale response.

Participants reported weighing different aspects against each other in their enrollment decision. Often they balanced their interest in furthering research against the potential for harms:

> If I could do something that can produce data that's gonna help other people in the future, not necessarily myself but for the people to come that would be very beneficial . . . there are some [medical procedures] I wouldn't want to do. If it involves sticking a needle in my head or surgery I wouldn't want to do it. And of course if its confidential. I wouldn't want my information out there. (Participant 122)

Despite the concerns around the invasiveness of testing, this participant was still 'very willing' to participate. Another participant who was 'a little' willing to enroll outlined her reasoning of the impact of the ambiguity of testing and the anxiety a positive result could cause on her own future, and weighed it with the benefits of research:

> I think in terms of the future, the importance of research, and you having the data. I would be concerned that I would have the marker, living with something that can't be cured. I would be thinking 'What can I do to mitigate living with this?' (Participant 023)

These examples indicate the complex and multilayered relationship between individuals' views and their willingness to participate in biomarker research. Some broad trends emerged, as certain themes were more consistently associated with motivating or discouraging willingness to enroll in biomarker research among this Black/African American cohort. No participants among those who were 'not at all' willing to participate expressed an interest in knowing their biomarker results or supporting research, while this was mentioned by 57% and 65% of those 'extremely' interested in research, respectively. Conversely, concerns about anxiety and the utility of testing tended to discourage participation: while 30% of those who were 'not at all' and 43% of those 'a little' willing to participate expressed anxiety about the psychological burden a positive test result would impose, this was mentioned by only 10% of those who were 'very', and 4% of those 'extremely' willing to participate. Similarly, while 30% of those 'not at all' and 36% of those 'a little' willing to participate questioned the utility of testing, this was a concern for 5% of those 'very' and none of those 'extremely' willing to participate.

Other themes were less closely related to enrollment willingness. The potential harms of testing were noted by almost two-thirds of those 'not at all' willing to participate, but among the remaining participants who were 'a little', 'somewhat', or 'very' willing, harms were cited in roughly equal proportion, around one-third of the time. The burdens of

testing and stigma around testing were variable in different groups.

DISCUSSION

This work adds to an understanding of factors that influence willingness to participate in AD biomarker research among Black/African Americans. Moreover, it increases the representativeness of the literature examining willingness to of potential participants to enroll in biomarker studies. Overall, individuals in the current cohort considered several motivating or discouraging factors when weighing whether to enroll in research. A fuller assessment of these themes is necessary to characterize the facilitators and barriers to biomarker research, and may suggest opportunities to increase enrollment [39]. Most biomarker and AD research has enrolled non-diverse samples, which limits the generalizability of findings, potentially undermining the provision of accurate diagnosis and appropriate treatment for Blacks/African Americans and other underrepresented groups. Thus, strategies to improve the inclusiveness of research are critical.

Motivations to participate in biomedical research can be complex. They may involve pragmatic aspects such as time investment or transportation [40], or personal attitudes such as trust or altruism around research [28, 41, 42]. The concerns motivating participation may also change over time, depending on participants' personal circumstances and relationships [43], and may continue because of a desire to continue a previous commitment to research [44]. Our study highlighted several of these themes that were particularly salient to enrolling in biomarker research, though it was not designed to clarify other aspects of the decision-making process, such as how much each individual theme influences willingness to enroll or how these might change over time. As expected, themes motivating participation in research were cited most frequently among those who were most willing to enroll in biomarker research. Themes discouraging research were cited most commonly among those least willing to participate. Individuals undecided about participating cited a mix of themes that influenced their decision. While this study identified themes relevant to enrollment, it was not designed to clarify other aspects of the decision-making process, such as how much each individual theme influences willingness to enroll. Arguably some concerns, such as the specific psychosocial consequences of biomarker testing, utility, and stigma are specific to this research, and informational material that concretely address these concerns may affect willingness to enroll. For instance, studies might provide information about the impact of disclosure on future planning during recruitment. Focusing on understanding personal risk for AD might involve more emphasis on explaining the value of biomarker information for prognosis.

The usefulness of testing has been primarily discussed from a theoretical perspective, rather than with evidence about participant viewpoints [45]. However, several individuals in our study questioned what the usefulness of a positive test result would be, a theme we term "utility". Around one-third of those who were 'not at all' or 'a little' willing to participate did not believe biomarkers had any utility, for instance because AD was not treatable. Some previous work has shown that withholding biomarker results does not change willingness to enroll, which may imply that the personal relevance of results does not influence decision-making [25]. The utility of biomarker results may become more salient in the future: with the recent approval of an amyloid-targeting agent, and additional similar agents in the pipeline [46], biomarker testing may lead to actionable information for participants.

Participants also felt that biomarkers would have limited utility because the results would be ambiguous. This is similar to findings from a qualitative study of long-term outcomes after disclosure. After being told they had elevated amyloid, individuals wanted more precise information than 'elevated' or 'not elevated' [47]. Efforts to refine prognosis are ongoing, and evidence from risk communication in other fields has also shown that information may need to be tailored to specific groups, and be presented using multiple strategies [48]. The current knowledge gap may provide an opportunity to explore if prognostic information influences enrollment, and what types of prognostic information are useful, such as timelines or other visualizations [49]. The significance reported by participants of the psychosocial impact of disclosure and utility of testing suggests that future research should examine trial designs with more prognostic elements and how willingness to participate in biomarker research is impacted by information about the consequences and individual benefits of testing.

Harms were a significant theme that discouraged willingness to enroll. This is consistent with other studies finding potential harms to be an important consideration for Black/African American groups

[29, 31]. Concerns about physical harms as a result of participating in biomarker research have been infrequently reported in the literature. In the limited existing data about harms, typically from White cohorts, individuals report concerns about potentially negative psychological consequences or stigma as reasons discouraging research participation [50]. However, this may be a specific concern among Blacks/African Americans [31], who are less willing to participate in research involving lumbar punctures than compared to Whites [26, 51]. While more research is needed on whether specifically lumbar punctures represent a barrier to research among Blacks/African Americans, the rapid progress towards blood-based biomarker testing may lower barriers to research participation [52].

Though our study was not designed to provide robust quantitative correlations, the number of times each theme was mentioned does suggest trends. It is notable that concerns about harms were relatively stable across groups who were 'a little', 'somewhat', or 'very' willing to participate. A possible explanation is that among individuals already participating in research, familiarity with study procedures or additional potential harms may not substantially change their willingness to participate in further research. Instead, they may decide to participate based on other factors (e.g., altruism or concerns about psychosocial outcomes). As our study did not generate the type of data necessary to explain this finding, this should be considered a hypothesis to explore in further studies.

Participants also cited concerns about negative psychological consequences and stigma as causing anxiety about health, as has been reported previously for prospective participants in biomarker studies [53]. Other work has shown that after disclosure, individuals with an "elevated" result may have a wider range of positive or negative outlooks on the future, in comparison to the more uniformly positive outlook expressed by those with a "not elevated" result [54]. Prior research using standardized mood assessments has shown that there is no increase in mood symptoms up to one year after disclosure, indicating that disclosure is generally safe [10, 55]. However, given the spectrum of psychosocial consequences cited in our study, such as feelings about "the end of one's useful life", it is possible that the consequences of biomarker disclosure may manifest in a number of ways, not all of which may be fully captured by standardized scales evaluating mood. Safety data also come from White, non-Hispanic individuals without significant mood disorders and in people willing to learn their biomarker results, which may not be not representative of clinical populations [56]. Future studies may try to characterize such consequences for health anxiety, and do so in populations reflecting a broader range of mental health experiences.

Previous research has shown that Blacks/African Americans are often reluctant to enroll in biomedical research because of negative experiences with research or feelings of mistrust. Proposed solutions have focused on increasing trust and community engagement [39]. We did not find that themes of mistrust or reputation of the researchers and institution were prominent. In our cohort, feelings of altruism were a significant motivating factor, which is perhaps not surprising given that participants were already involved in research. For a handful of participants ($n = 5$), this altruism was linked to specific desire to help the Black/African American community through research. This finding is similar to other work that has shown altruism to be an important motivator for joining AD biomarker research [27, 57]. Altruism is a major factor motivating participation in AD research among Blacks/African Americans [28]. This may have important implications for increasing the involvement of Blacks/African Americans who are already participating in non-biomarker research. Further research could explore whether enrollment is impacted by researchers sharing the importance of biomarker research, or how it relates to other research the participants are engaged in. Biomarker research is closely directed at diagnosis and treatment, which may appeal to those who are participating in AD research to find treatment (as some of our participants suggested in the above quotes). Mistrust may not have been a prominent theme due to a difference in samples: because participants in our study were already engaged in research, they may have already developed higher levels of trust versus community participants without previous research involvement. This finding may also indicate that trust develops, or mistrust decreases, with increased time and engagement in research. Future research could explore how attitudes vary not only among underrepresented groups, but also among recruitment source (e.g., already involved in research versus community-based).

This study has several limitations. First, enrollment of samples into AD research has been influenced by recruitment strategies [33, 58], and these research samples may not reflect the composition of future clinical populations [56]. Our sample was drawn from participants who are already extensively involved

with AD research and may hold views that differ from more general populations. Our sample also had high levels of education, and higher educational attainment is associated with more interest in research participation among Blacks/African-Americans and other groups [40, 59, 60]. The prior involvement in research and levels of education may also limit the ability to generalize to other Black/African American populations not already involved in research, since a main barrier—trust—may not have been as salient for our sample. Individuals in our sample may have had a higher interest in learning their biomarker results, as many were already enrolled in longitudinal studies because of their family history of AD. Increased risk due to family history of AD has been associated with a higher interest in participating in AD disclosure research [22]. Finally, our population was primarily composed of women (74%), and was too small to discern differences between genders. These limitations suggest the importance making research populations more inclusive in not only in terms of racial and ethnically minoritized status, but also regarding gender, levels of education, and prior involvement in research.

Second, methodological limitations include the necessity of using a vignette. The vignette instructed individuals to ignore factors such as the time the study would take or travel involved. This may have resulted in the importance of burdens being under-reported in our sample, since some participants mentioned burdens despite these instructions. Participants also responded to a hypothetical question, which might not reliably predict their actual enrollment in research in the future, or their reasons for doing so. Finally, data was generated from a free response item, but we were not able to include follow-up questions. This is best suited to identify important themes that are related to enrollment, and can suggest relationships between themes and a decision to enroll, but does not provide more comprehensive information about participants' reasoning.

Conclusion

This study examined themes influencing Black/African American participation in hypothetical biomarker research among a group of individuals involved with AD research. In line with prior work, altruistic support for research and a desire to know one's personal biomarker result were themes that motivated a desire to enroll. Themes discouraging research participation were possible psychosocial effects, harms, burdens, and stigma. These data suggest that a concern about the utility of results is more prominent than previously reported. Based on these findings, there may be opportunities for improving the understanding of potential participants, particularly with regard to potential personal benefits of biomarker research (e.g., addressing modifiable risk factors or long-term planning). This could initially focus on increasing participation among those individuals already involved in research, and later be leveraged to include more general populations. Further, decisions to enroll in research are complex. A better understanding of how decisions to enroll are related to specific motivating or discouraging themes may offer opportunities to positively impact research enrollment, particularly for those from underrepresented groups, as the field strives toward more inclusion and representation.

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