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Original Research

Knowledge About Genetics Among African Americans

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Although knowledge about genetic concepts is important for individuals to be active participants in medical technologies that use genetic science, limited information is available on knowledge about basic genetic concepts and terminology in African Americans. The purpose of this study was to evaluate knowledge about general genetic concepts and medical genetics terminology among African Americans and to identify factors having independent associations with knowledge. Participants were 109 adult African Americans enrolled in a study on attitudes about race, genetics, and smoking. The majority of respondents were knowledgeable about general genetic concepts, but were less knowledgeable about medical genetics terminology. Education was the only factor independently associated with knowledge about sporadic disorders in multivariate logistic regression analysis. Respondents with at least some college education were most likely to be knowledgeable about sporadic disorders (OR = 2.70, 95% CI = 1.10, 6.67, $p = .03$). The results of this study suggest that genetics education targeted to African Americans may need to focus on increasing understanding about technical concepts related to genetics.

KEY WORDS: African American; genetics; knowledge.

INTRODUCTION

Since the completion of the Human Genome Project (HGP), knowledge about the genetic basis of many common diseases has increased substantially; research is now being conducted to identify genetic variants in neurotransmitter pathways (e.g., dopamine) that play a role in risk behaviors such as cigarette smoking (Lerman, Patterson, and Berrettini, 2005). As discoveries about genetic risk factors for disease and behaviors continue to be made, it is anticipated that genetic-based medicine will become more routine in clinical settings (Collins and Guttmacher, 2001; Collins and McKusick, 2001). Prior reports have emphasized the importance of first ascertaining patient's knowledge of basic factual information before providing clinical care, especially with new technology, to ensure informed decision-making and that the full benefits of services are realized (Lanie *et al.*, 2004; Richards and Ponder, 1996). Thus, to be an active participant in decision-making about medical technologies that use genetic science, individuals need to be knowledgeable about genetic concepts and some medical genetics terminology (McInerney, 2002; Richards and Ponder, 1996; Lin-Fu and Lloyd-Puryear, 2000). However, previous research has shown that most individuals do not understand basic genetic concepts (Lanie *et al.*, 2004; Emery *et al.*, 1998).

To facilitate decisions about genetic-based medicine, genetic counseling and education are recommended to ensure that individuals understand concepts about genetics and genetic terminology (Smith, 1998; Walker, 1998). This may include provision of education about terms such as genes and chromosomes to facilitate understanding of the

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contribution of these factors to disease and behavior and counseling may include discussion about concepts such as family history and characteristics of disorders (e.g., sporadic conditions versus hereditary disease) to facilitate comprehension of risk information (Smith, 1998; Walker, 1998). As genetic technology continues to evolve, the terminology used in clinical practice may be expanded to include education about concepts such as the "genome" to explain different types of analysis (e.g., genome-wide scans). However, as genetic testing becomes more commonplace in clinical settings, it is likely that comprehensive genetic counseling and education may not be widely available due to the limited number of genetic counselors and medical geneticists (Cooksey *et al*., 2005); thus, developing a better understanding of knowledge about general genetic concepts and terminology may be especially important to identify areas where educational efforts should be focused.

Previous studies have shown that knowledge about breast cancer genetics and the ways in which genetic testing may be used to understand disease risks (e.g., predictive testing) is significantly lower among African Americans compared to Caucasians (Donovan and Tucker, 2000; Hughes *et al*., 1997; Singer *et al*., 2004). Recent work has also shown that knowledge about other types of genetic disorders (e.g., sickle cell disease) is limited among African Americans (Boyd *et al*., 2005). However, knowledge about the role of genetics in specific diseases or knowledge about applications of genetic tests may not translate into knowledge about general genetic concepts. Moreover, although understanding about basic medical genetics terms such as genes, heredity, and mutations has been evaluated in prior qualitative studies (Lanie *et al*., 2004; Emery *et al*., 1998; Condit *et al*., 2004), African American participation in this research has been limited. Knowledge about basic genetic concepts and terminology is an aspect of genetics literacy (Wang, Bowen, and Kardia, 2005) that is important for integrating genetics into public health practice (Kardia and Wang, 2005). Moreover, improving knowledge about basic genetic concepts and terminology is an important outcome of genetic counseling that is needed to understand the contribution of genes to disease and behavior as well as comprehension of risk information (Smith, 1998; Wang *et al*., 2004). Thus, it is important to determine the extent to which African Americans are knowledgeable about basic concepts and terminology that are likely to be addressed as a part of genetic counseling and education.

The objective of the present study was to evaluate general knowledge about genetic concepts in a sample of African American men and women who were participating in a study on attitudes about race, genetics, and smoking. While prior studies have evaluated knowledge about genetic factors involved in specific disorders (Hughes *et al*., 1997; Donovan and Tucker, 2000) or assessed understanding about genetic concepts using qualitative methods (Lanie *et al*., 2004; Condit *et al*., 2004), we were interested in evaluating concepts relating to knowledge about family history, types of disorders, and medical genetics terminology (e.g., genome, mutations, chromosomes) using quantitative methodology. Further, we evaluated knowledge about basic genetic concepts and terminology in the present study because these areas are aspects of genetics literacy (Wang, Bowen, and Kardia, 2005) and are likely to be addressed as part of genetic counseling and education regardless of if these services are provided to facilitate informed decisions about testing for mutations associated with specific diseases (e.g., hereditary breast cancer) or genetic variants associated with risk behaviors. As part of this evaluation, we were also interested in identifying sociodemographic characteristics and clinical factors that were associated with genetics knowledge. Since prior reports have shown that people have a variety of beliefs about the influence of genetics on disease risk and behaviors (Parrott *et al*., 2003), but to our knowledge, studies have not explored the extent to which these beliefs may be related to knowledge about genetics, we also evaluated the relationship between knowledge and beliefs about the influence of genetics on smoking in the present study. Based on prior studies showing that knowledge about mutations for specific conditions is associated with health care decisions (e.g., genetic test result acceptance, participation in genetic counseling) (Lerman *et al*., 1996; Thompson *et al*., 2002), we also evaluated the relationship between knowledge and smoking behaviors since smoking was the overarching context for the study and these behaviors have important implications on health. An additional objective of this study was to explore the association between the type of health care facility where individuals usually obtained their medical care and knowledge about genetics since health care providers are an important source of health information (Singer *et al*., 2004). Developing a better understanding of knowledge about genetic concepts and terms specifically among African Americans is needed to identify areas where educational efforts

may need to be focused as genetic services are targeted to this population (Halbert *et al.*, 2005).

METHODS

Study Population

Participants were African American men and women who were participating in a study on attitudes about race, smoking, and genetics research. To be eligible for study participation, individuals had to self-identify as being African American or Black and be at least 18 years of age. To obtain data on race, respondents were read a list of racial categories and were asked to indicate their racial background (e.g., African American, Caucasian). Similar methods have been used in national surveys to obtain racial background (e.g., Behavioral Risk Factor Surveillance Survey). The study was approved by the institutional review board at the University of Pennsylvania.

Procedures

Eligible subjects were recruited into the study through self-referrals from newspaper advertisements. The study was described as a research project designed to understand attitudes about race, genetics, and cigarette smoking. Individuals interested in participating in the study were directed to call a study line for additional information. All data were collected by self-report during a structured 20-minute telephone interview that was completed by a trained interviewer from Penn after obtaining verbal consent. The survey obtained information on sociodemographics, clinical factors, beliefs about genetic factors involved in tobacco use, and attitudes about genetic testing for smoking susceptibility. Of the 233 individuals who self-referred for study participation, 82% ($n = 191$) completed the survey. Individuals who were missing data for sociodemographic questions ($n = 8$) were excluded from the analysis. Because items measuring knowledge about genetic concepts were added to the survey after study recruitment began, some of the 183 individuals with complete baseline data ($n = 74$), did not complete these items. Thus, the sample for the present report is a subset of respondents ($n = 109$) who completed knowledge items. There were no differences between respondents who completed the knowledge items and those who did not complete these measures in terms of sociodemographics (χ^2 marital status $= 1.06$, $p = 0.30$; χ^2 education $= 0.07$, $p = 0.78$; χ^2 income $= 0.02$, $p = 0.90$; t-value for age $= 0.98$, $p = 0.33$), clinical factors (χ^2 family history of lung cancer $= 0.69$, $p = 0.41$; χ^2 smoking $= 0.003$, $p = 0.96$) or beliefs about the influence of genes on tobacco use ($\chi^2 = 0.19$, $p = 0.67$).

Measures

Sociodemographic Characteristics

Age, marital status, income, education, and employment status were obtained. We re-coded these items into dichotomous variables (e.g., married versus not married) based on the distribution of responses.

Clinical Factors

Family history of lung cancer in a first-degree relative was evaluated by asking respondents if their parents, siblings, or children had ever been diagnosed with lung cancer (yes or no). Smoking status was evaluated by one item adapted from the Behavioral Risk Factor Surveillance Survey that asked respondents if they had ever used cigarettes (1 = use now, 2 = quit using, 3 = never used).

Source of Medical Care

Respondents were asked to indicate the type of facility where they normally obtained medical care (e.g., doctor's office, clinic or health center, HMO, hospital emergency room, or hospital outpatient department) using one item adapted from the Behavioral Risk Factor Surveillance Survey (CDC, 2001)

Beliefs About Genetics

We used one Likert-style item to evaluate beliefs about the influence of genetic factors on smoking behavior. Specifically, respondents were asked to indicate how much influence they believed biological factors such as genes have on whether someone starts to smoke cigarettes (1 = none at all, 2 = a little, 3 = a moderate amount, 4 = a lot). We re-coded responses

to this item into a dichotomous variable (none/a little versus moderate/a lot) based on the distribution of responses to facilitate interpretation of results.

Knowledge About Genetics

Knowledge was defined as recognition and understanding of basic genetic concepts and terminology. We used five newly developed multiple-choice items to evaluate genetics knowledge including concepts related to family history and sporadic disorders and knowledge about medical genetics terminology for the words mutation, genome, and chromosome. For example, respondents were asked "who are first-degree relatives" to evaluate knowledge about concepts related to family history and we asked respondents "how many chromosomes do humans have" to evaluate knowledge of medical genetics terminology. We evaluated knowledge about these factors based on the concepts and terms that are likely to be used in genetic counseling and education protocols provided to facilitate informed decision-making about utilization of genetic services (Smith, 1998; Walker, 1998).

Knowledge questions were developed using items from the glossaries of publicly available websites that provide information about genes, genetic counseling, and genetic testing to potential consumers and health care providers (e.g., www.geneclinics.org and www.genome.gov) after reviewing the literature to identify key outcomes of genetic counseling and education. Knowledge items were developed by a board-certified genetic counselor with several years of clinical experience (LK) and reviewed by an investigator with extensive experience in developing items to evaluate outcomes of genetic counseling and testing (CHH) (Hughes *et al*., 1997; Hughes *et al*., 2002; Cella *et al*., 2002). Response options for each knowledge item were read using a structured script and respondents were asked to indicate which option was the correct answer. Since the genetic concepts and terminology we evaluated in the present study were distinct and were not related to a specific disorder or condition and did not focus on a central domain related about genetics as in prior reports (e.g., risk associated with mutations) (Hughes *et al*., 1997; Donovan and Tucker, 2000), we did not create a summary index; rather, responses to each knowledge item were evaluated separately and were categorized as being correct or incorrect. Similar items have been used to evaluate knowledge about specific genetic diseases (e.g., hereditary breast cancer, sickle cell disease) among African Americans in previous studies (Hughes *et al*., 1997; Boyd *et al*., 2005).

Data Analysis

Descriptive statistics were generated to characterize respondents in terms of sociodemographic factors, clinical characteristics, and exposure to tobacco. Frequencies were also generated for knowledge items. Chi square tests of association were conducted to identify factors associated with genetics knowledge. We then used logistic regression analysis to identify factors having independent associations with genetics knowledge. Variables were entered into the model simultaneously. Since general knowledge about genetic concepts and terms have not been evaluated specifically among African Americans, variables that had an association of $p < .10$ with knowledge items were included in the regression model for each item.

RESULTS

Sample Characteristics

Participants were 109 African American men and women. Forty-three percent of respondents were men and 57% were women (see Table I). Most respondents were not married (81%), had some college education or were college graduates (61%), were employed (53%), and had an annual income greater than $20,000 (52%). Most respondents had health insurance (81%) and usually received their medical care at a doctor's office (54%). Seventy-one percent of respondents were current smokers and 12% of respondents had a family history of lung cancer. Since the most of the sample were smokers, we conducted bivariate analyses to determine if smoking status was associated with any of the sociodemographic variables and beliefs about the influence of genes on tobacco use. As shown in Table I, smoking status was not associated significantly with gender, marital status, education level, employment status, income, or health care facility. Smoking status was also not associated significantly with beliefs about the influence of genes on tobacco use ($\chi^2 = 0.73$, $p = 0.39$). However, the mean age of smokers was significantly higher

Table I. Sample Characteristics

Variable	Label	Total *n*(%)	Smoking Status		χ^2
			Smokers *n*(%)	Non-Smokers *n*(%)	
Gender	Female	62 (57)	40 (64)	22 (35)	2.60
	Male	47 (43)	37 (78)	10 (21)	
Marital status	Married	21 (19)	15 (71)	6 (29)	0.008
	Not married	88 (81)	62 (70)	26 (30)	
Education level	≥ Some college	67 (61)	43 (64)	24 (36)	3.50†
	≤ High school	42 (39)	34 (81)	8 (19)	
Employment	Employed	58 (53)	38 (66)	20 (34)	1.57
	Not employed	51 (47)	39 (76)	12 (24)	
Income	>$20,000	57 (52)	36 (63)	21 (37)	3.23†
	<$20,000	52 (48)	41 (79)	11 (21)	
Family history of lung cancer	Yes	13 (12)	9 (69)	4 (31)	0.01
	No	96 (88)	68 (71)	28 (29)	
Health care facility	Doctors' office	59 (54)	40 (68)	19 (32)	0.50
	Other	50 (46)	37 (74)	13 (26)	

Note. Age (Mean, SD): Smoker (45.7, 10.6), Non-Smoker (40.1, 13.0), $t = 2.33$, $p = 0.02$, $^{+}p < 0.10$.

than the mean age for non-smokers. The mean (SD) age of respondents overall was 44.1 (11.6).

Descriptive Information on Genetics Knowledge

As shown in Table II, most respondents were knowledgeable about family history, but were less knowledgeable about medical genetics terminology. For example, 74% of respondents knew that mothers and daughters were first-degree relatives whereas only 22% of respondents knew that humans have 46 chromosomes. Further, while close to two-thirds of respondents knew that a sporadic disorder was one that occurs by chance and is not likely to happen again in families, only a little more than 50% of respondents knew that a mutation was any change in a gene from its natural state. Two items measuring knowledge about sporadic disorders and mutations were selected for further analysis based on the proportion of respondents who answered these questions correctly.

Factors Associated with Genetics Knowledge

As shown in Table III, education, income, smoking status, and beliefs about the influence of genetic factors on smoking were associated significantly with knowledge about sporadic disorders. Respondents who were college graduates and those with some college education were significantly more likely to be knowledgeable about sporadic disorders

Table II. Percent of Respondents with Correct Responses to Genetic Knowledge Items

Item	Correct (%)
First-degree relatives are mother and daughter.[a]	74
A sporadic disorder is one that occurs by chance and is not likely to happen again in families.[b]	57
A mutation is any change in a gene from its natural state.[c]	52
A genome is the complete DNA sequence, containing all genetic information and supporting proteins, in the chromosomes of an individual or species.[d]	26
Humans have 46 chromosomes.[e]	22

Note. Questions asked respondents (correct response is provided in **bold**).

[a]Who are first-degree relatives: **(a) mother and daughter**, (b) daughter and grandmother, (c) brother and stepsister, (d) brother and aunt, (e) don't know.

[b]What is a sporadic disorder: (a) a disorder that runs in families, **(b) a disorder that occurs by chance and is not likely to happen again in families**, (c) a disorder that can be passed on by women only, (d) a disorder that only affects women, (e) don't know.

[c]What is a mutation: (a) the occurrence of one or more extra or missing chromosomes, (b) an identical copy of a DNA sequence or entire gene, **(c) any change in a gene from its natural state**, (d) a specific region or amino acid sequence in a protein, (e) don't know.

[d]What is a genome: **(a) the complete DNA sequence, containing all genetic information and supporting proteins, in the chromosomes of an individual or species**, (b) a specialized structure that perform certain tasks within the cell, (c) a basic unit of heredity, (d) one of several different testing methods that reveals either the structure or function of a particular protein product, (e) don't know.

[e]How many chromosomes do humans have: (a) 23, (b) 26, **(c) 46**, (d) 43, (e) don't know.

Table III. Factors Associated with Genetics Knowledge

Variable	Level	Sporadic Disorder Correct (%)	Mutation Correct (%)
Gender	Male	57	43[d]
	Female	56	60
Marital status	Married	62	33[c]
	Not married	56	57
Education level	≥ Some college	70[a]	58
	≤ High school	36	43
Employment status	Employed	60	59
	Not employed	53	45
Income level	≥ $20,000	70[b]	60
	≤ $20,000	42	44
Smoking status	Current smoker	51[c]	51
	Former/never smoker	72	56
Family history of lung cancer	Yes	54	69
	No	57	50
Health care facility	Doctors' office	64[d]	59
	Other	48	44
Beliefs about the influence of genes on cigarette smoking	None/a little	67[c]	63[c]
	Moderate/a lot	48	43

Note. Sporadic Disorder: Age (Mean, [SD]), Correct = (43.2, [12.3]), Incorrect = (48.3 [10.6]), $t = 0.88$, $p = 0.38$.
Mutation: Age (Mean, [SD]), Correct = (44.5, [11.8]), Incorrect = (43.6 [11.4]), $t = 0.43$, $p = 0.66$.
[a] $p < .0001$.
[b] $p < .01$.
[c] $p < .05$.
[d] $p < .10$

compared to those with less education ($\chi^2 = 12.48$, $p = .0004$). Respondents with incomes greater than $20,000 ($\chi^2 = 8.61$, $p = .003$) and those who were former or never smokers ($\chi^2 = 4.15$, $p = .04$) were also most likely to be knowledgeable about sporadic disorders. However, respondents who believed that biological factors such as genes have no or a little influence on smoking were significantly more likely to be knowledgeable about sporadic disorders compared to those who believed that genes have more influence on smoking behaviors ($\chi^2 = 3.74$, $p = .05$). Respondents who received care at a doctor's office were also likely to be knowledgeable about sporadic disorders ($\chi^2 = 2.97$, $p = .08$). As shown in Table IV, greater education level was the only factor independently associated with knowledge about sporadic disorders in the logistic regression analysis.

With respect to knowledge about mutations, marital status and beliefs about the influence of genetic factors were associated significantly with knowledge about this term. Respondents who were not married were significantly more likely to be knowledgeable about mutations compared to those who were married ($\chi^2 = 3.74$, $p = .05$). In addition, respondents who believed that genes have no or a little influence on smoking were significantly more likely to be knowledgeable about mutations compared to those who believed that genes have more influence on smoking behaviors ($\chi^2 = 4.20$, $p = .04$). No other variables were associated significantly with knowledge about mutations.

DISCUSSION

Genetic testing for mutations associated with hereditary forms of disease (e.g., breast cancer) is now available and it is anticipated that testing for genetic variants associated with common risk behaviors such as smoking will be available in the future (Shields *et al.*, 2005). It has been suggested that patients' understanding of basic concepts and terminology should be evaluated prior to provision of clinical services such as genetic testing to ensure informed decision-making (Lanie *et al.*, 2004; Richards and Ponder, 1996). However, limited information is available on knowledge about basic genetic concepts and

Table IV. Logistic Regression Model of Genetics Knowledge

		Sporadic Disorder		
Variable	Level	OR	95% CI	*P*-value
Education level	≥ Some college[a]	2.71	1.10	0.03
	≤ High school		6.67	
Income level	≥ $20,000	1.99	0.80	0.14
	≤ $20,000		4.90	
Smoking status	Current smoker	0.52	0.20	0.19
	Never/former smoker		1.38	
Beliefs about the influence of genes	Moderate/a lot	0.50	0.21	0.11
	None/a little		1.16	
Health care facility	Doctors' office	0.40	0.63	0.36
	Other		3.51	
		Mutations		
Gender	Male	1.80	0.82	0.15
	Female		4.00	
Marital status	Married	0.46	0.16	0.13
	Not married		1.28	
Beliefs about the influence of genes	Moderate/a lot	0.49	0.22	0.08
	None/a little		1.08	

[a]Education was associated significantly with income ($\chi^2 = 18.66$, $p = 0.001$); however, this relationship did not result in multicollinearity (r for the coefficient $= -0.32$).

terminology in African Americans. This study evaluated knowledge about genetic concepts in a sample of African American men and women. Overall, most respondents were knowledgeable about concepts related to family history, but were less knowledgeable about basic medical genetics terminology. For example, only about one-fourth of respondents knew that the genome is the complete DNA sequence and that humans have 46 chromosomes. These findings are consistent with prior reports that have shown that knowledge about genetic factors involved in specific diseases may be low among African Americans (Hughes *et al*., 1997; Donovan and Tucker, 2000; Kinney *et al*., 2001). Since limited knowledge may be a barrier to utilization of genetic counseling and testing in African Americans (Thompson *et al*., 2002), it may be important to increase knowledge about genetics to enhance access to genetic services. Our study suggests that educational efforts targeted to African Americans may need to focus on improving knowledge about medical genetics terminology.

We also found that respondents who were college graduates and those with some college education were about three times more likely than respondents with less education to be knowledgeable about the characteristics of sporadic disorders. It is possible that respondents with greater education were most likely to be knowledgeable about sporadic disorders because of more exposure to information about genetic testing (Lukoschek *et al*., 2003). Individuals with some college education and those who are college graduates may have also received education about genetic concepts as part of their college courses or through other types of informational resources. Previous research has shown that greater education is associated with higher rates of participation in genetic counseling for hereditary cancer (Lerman *et al*., 1999) and education about genetic testing (Walter *et al*., 2004). It is important to note, however, that education level was not associated significantly with knowledge about mutations. These findings suggest that education level may be most important to knowledge about complex genetic concepts that is influenced by one's ability to integrate factual information about disease characteristics and familial experiences with disease. Recent research has demonstrated that the number of family members diagnosed with a condition contributes to beliefs about the heritability of disease (Paasche-Orlow *et al*., 2005). At the same time, however, other work has shown that comprehension of general health information and information about disease risks is positively associated with greater levels of formal education (Lerman *et al*., 1995; Lerman *et al*., 1997). It is possible that a greater level of formal education facilitates integration of one's familial experiences with disease and factual knowledge about disease characteristics; this may contribute to increased

knowledge about the characteristics of sporadic disorders. However, additional research is needed to evaluate knowledge about the characteristics of hereditary disease and to determine whether or not individuals are able to distinguish the features of sporadic diseases from hereditary conditions.

In considering the results of this study, several limitations should be noted. First, we used newly developed items to evaluate knowledge about genetic concepts and medical genetics terminology. However, the items that we used had acceptable face validity and the patterns of knowledge about genetic concepts found in the present study were consistent with findings from previous studies that demonstrated less knowledge about complex disorders that have a genetic basis (Hughes *et al*., 1997; Boyd *et al*., 2005). Nonetheless, future studies are needed to evaluate the reliability and validity of these items, especially with respect to the decisions about utilization of genetic services. It is also possible that responses to some knowledge items were incorrect because of the complexity of the definitions provided to respondents; alternatively, it is not clear to what extent chance played a role in provision of correct responses. However, similar methods have been used to evaluate knowledge about genetic factors involved in specific diseases (Hughes *et al*., 1997; Singer *et al*., 2004; Boyd *et al*., 2005) and we based the definitions for each knowledge item on those that are provided in public education forums about genetics (e.g., the National Human Genome Research Institute Glossary of Genetic Terms). Additional limitations are that the methods used to recruit participants may reduce the generalizability of our results due to self-selection bias and the cross-sectional nature of the study prevents us from establishing the causal determinants of knowledge about genetic concepts. Because our sample only included 109 African Americans, most of whom were smokers, we had limited statistical power to detect differences in knowledge and the generalizability of our findings may be limited because of the large proportion of smokers who were enrolled in the study. However, smoking status was not associated with any of the sociodemographic variables that were related to knowledge; thus, smoking status is not likely to be a confounder. While our sample was similar to Philadelphia residents included in the 2000 Census in terms of gender, marital status, and employment status, more than 70% of participants in our study had some college education. Thus, future studies are needed to evaluate knowledge about genetic concepts and terminology in larger, population-based samples of African Americans who are recruited using methods with less potential for self-selection bias. We also did not evaluate racial group differences in knowledge. This underscores the need for future studies that evaluate racial differences in knowledge about basic genetic concepts and medical genetics terminology among other ethnic groups. Since our report focused on evaluating knowledge about general genetic concepts and terms, we did not measure the association between knowledge and health behaviors specific to genetic testing. Thus, future studies are needed to evaluate these relationships as well as assess beliefs about the role that genes play in disease among African Americans.

Despite these potential limitations, the present study suggests that knowledge about genetic concepts and terminology may vary substantially in African Americans. Respondents were most knowledgeable about concepts related to family history, but had less knowledge about medical genetics terminology. Our findings underscore the importance of developing educational efforts to improve knowledge about medical genetics terms among African Americans. As genetic-based medicine becomes more integrated into clinical settings, health care providers are likely to be an important resource for information about genetic concepts. However, previous research has shown that health care providers may not be comfortable addressing genetic issues with patients (Fry *et al*., 1999; Watson *et al*., 2001). An even more important issue may be that it is not logistically possible to address educational needs related to genetic concepts and terminology during the limited time frame for medical care visits. Referral to genetic counselors for more intensive education about genetic concepts may be one way to improve knowledge about genetics among African Americans without impacting the amount of time that patients have with physicians. However, there are a limited number of genetics professionals available to provide education; thus, alternative methods will be needed to improve knowledge about genetic concepts and terminology (Cooksey *et al*., 2005). Recent research has shown that computer-based educational programs may be effective for providing education about genetic factors involved in specific diseases (Green *et al*., 2004). This approach may also be useful for enhancing knowledge about genetics among African Americans. Future studies are needed to develop and evaluate alternate strategies for improving knowledge about genetics among African Americans.

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