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THE ROLE OF RISK PERCEPTION IN FLU VACCINE BEHAVIOR AMONG AFRICAN AMERICAN AND WHITE ADULTS IN THE US

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Abstract

Seasonal flu vaccination rates are low for US adults with significant disparities between African and White Americans. Risk perception is a significant predictor of vaccine behavior but the research on this construct has been flawed. This study addressed critical research questions to understand the differences between African and White Americans in the role of risk perception in flu vaccine behavior: 1. What is the dimensionality of risk perception and does it differ between the two races? 2. Were risk perceptions of White and African American populations different and how were sociodemographic characteristics related to risk for each group? 3. What is the relation between risk perception and flu vaccine behaviors for African Americans and Whites?

The sample, drawn from GfK's Knowledge Panel, consisted of 838 Whites and 819 African Americans. The survey instrument was developed from qualitative research. Measures of risk perception included cognitive and emotional measures of disease risk and risk of side effects from the vaccine. The online survey was conducted in March of 2015.

Results showed the importance of risk perception in the vaccine decision-making process for both racial groups. As expected, those who got the vaccine reported higher disease risk than those who did not. Separate cognitive and emotional factors did not materialize in this study but strong evidence was found to support the importance of considering disease risk as well as risk of the vaccine. There were significant racial differences in the way risk perception predicted behavior.

Keywords

Risk perception; seasonal flu vaccination; health disparities; African American

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Despite CDC's recommendation that all adults get a seasonal flu vaccine every year, and the widespread availability of free and low cost vaccines, only 42.2% of American adults were vaccinated in the 2013–14 flu season.⁽¹⁾ Even more disturbing were the disparities between African American and White adults: only 41.5% of African American adults were vaccinated, compared to 47.4% of White adults.⁽¹⁾ Despite a significant research commitment to explain vaccination behaviors, a satisfying explanation for low vaccine uptake rates is still elusive.⁽²⁾ Risk perception is one of the most obvious concepts to study but it is also where previous research has been significantly criticized.⁽³⁾ To the extent that it is possible with a cross-sectional study, this article addresses some of these criticisms to achieve a better understanding of how risk perception differs for both African American and White populations.

Perceived risk is the extent to which an individual believes that he/she is subject to a threat. The prevailing belief is that greater perceived risk will motivate individuals into health-protective behaviors.⁽⁴⁾ Yet, despite a large and growing body of research, the function of risk perception in vaccine decisions remains imperfectly understood.

1.0 RESEARCH QUESTIONS

We identified three research questions: 1. What is the dimensionality of risk perception and does it differ for White and African Americans? 2. Were risk perceptions of White and African American populations different and how were sociodemographic characteristics related to risk for each group? 3. What is the relation between risk perception and flu vaccine behaviors for African Americans and Whites?

1.1 Q1: What is the dimensionality of risk perception and does it differ for White and African Americans?

Despite considerable research on risk perception, there is no general consensus on three points related to its dimensionality and measurement: 1) whether risk is strictly cognitive or also affective; 2) whether, in the case of vaccination, perceptions of both disease and vaccine risk need to be considered; and 3) how an individual's perceived risk may vary before and after engaging in a preventive behavior such as vaccination.

Traditionally, risk has been assumed to be a strictly cognitive process,⁽⁵⁾ measured by two dimensions: perceived susceptibility, or the probability of an outcome, and perceived severity, or the magnitude of an outcome.⁽⁴⁾ Perceived susceptibility may also be captured by similar concepts such as perceived likelihood or perceived vulnerability. Immunization research typically includes the perceived susceptibility and severity of vaccine preventable disease.⁽³⁾

In the past decade, researchers have challenged the concept of risk perception as only cognitive, asserting that uncertainty includes both cognitive and affective aspects.^(5–10) Recognizing the importance of affect, or an individual's overall positive/negative emotional state, researchers began incorporating affect as a component of risk assessment, including anxiety,⁽¹¹⁾ regret,^(12, 8, 13, 14) worry,^(8, 15) anger,⁽¹⁶⁾ and negative affect.⁽¹⁷⁾ Slovic proposed

a ‘dual-process’ system divided between “risk as analysis” and “risk as feelings,”^(9, 18) in which emotions act as mediators between cognitive processes and behaviors.⁽⁹⁾ This “affect heuristic” may bias perceptions, with emotion overriding rational decision making.^(6, 19) Evidence suggests that models addressing both affective and cognitive dimensions are more predictive than the traditional cognitive models.^(20, 7) Therefore in our study we include both.

As immunization campaigns successfully eradicate once-common diseases, there is a tendency for individuals to lose sight of potential risks from disease and instead fixate on potential risks that could arise from vaccination.⁽²¹⁾ Traditional risk assessment research on immunization focuses on perceived risk of vaccine-preventable disease, conditioning risk on not taking a vaccine.⁽³⁾ As vaccine-adverse side effects become more widely discussed in the media, researchers acknowledge the need to assess perceived risk of vaccine side effects for a more complete appraisal of risks.^(22, 23)

Several studies have assessed the relation between disease risk and perceived risk of side effects, as a determinant in childhood vaccination,⁽²⁴⁾ among high-risk groups,⁽²⁵⁾ as well as vaccination in the population more generally.⁽²⁶⁾ This research suggests that fear of side effects is salient in vaccination decisions, particularly among non-vaccinators. Yet, methodologically, these assessments tend to employ different measurement for each aspect – risk of disease measured differently from vaccine risks. One common approach is described as “omission bias,” a cognitive heuristic, where individuals perceive risks of deliberate action (in this instance, vaccination) to be more detrimental than risks of inaction (not getting vaccinated).⁽²⁾ Evidence suggests that this bias is heavily influential in parental decisions regarding childhood vaccines,^(27–29) and perhaps plays a role in adult vaccination as well.⁽³⁰⁾

Wheelock et al. argued that research needs to assess interactions between the major elements of disease risk, susceptibility and severity,⁽²²⁾ to extend this line of reasoning; we would argue that research also needs to assess the interaction between vaccine risk and disease risk. We found only one project assessed both disease and vaccine risks using the same metrics. In Germany, Renner and Reuter assessed cognitive and affective risk of both H1N1 influenza as well as H1N1 vaccine side effects, concluding that vaccination intentions were shaped by the interplay of affective assessment of both disease and vaccine risks.⁽³¹⁾ In our study, we measured disease risk and vaccine risk with identical questions.

A final methodological issue relates to temporality; to accurately assess perceived risk, it needs to be conditioned on vaccine behaviors.⁽³²⁾ Following this advice is challenging for cross-sectional designs. There are two competing temporal explanations: the motivation hypothesis, which suggests that risk perceptions precede and produce protective behaviors, and the risk reappraisal hypothesis, which suggests that after taking a preventive action, individuals perceive lower risk.^(3, 4) It is necessary for researchers to be explicit when assessing risk, including both a conditioning statement, as well as a specific time frame.⁽³⁾ We conducted this study in March, after CDC data suggest most adults who will get a flu vaccine have already done so. In order to address the temporality issue, we asked the risk

perception questions differently for those who had already had the flu vaccine, for those who still intended to get it, and for those who did not intend to get it.

1.2 Q2: Were risk perceptions of White and African American populations different and how were sociodemographic characteristics related to risk for each group?

A common assumption in all risk perception research is that demographic differences contribute to differential perception of risk.⁽³³⁾ Researchers have identified a “White Male Effect” (WME) whereby white men perceive lower risks when compared to women and minority groups, across a variety of risk scenarios.^(34–37) More generally, Boholm hypothesized that a ‘feeling of security’ within society is at the heart of these perceived differences in risk, impacting all marginalized groups.⁽³³⁾ Recent research by Olofsson and Rashid revealed that in Sweden, where there are much greater levels of gender equality, the gender disparity in perceived risk is minimal. However, there was evidence that non-natives felt greater risks than native-born Swedes, indicating that social inequality is at the heart of this phenomenon.⁽³⁷⁾ They call for further research exploring risk in marginalized groups, renaming the “White Male Effect” as the “Social Inequality Effect” and advocating for an intersectional understanding of inequality.^(37–39)

Assessing risk within the African American community, researchers found no effects as strong as the WME, but rather great heterogeneity within the population.⁽⁴⁰⁾ While there has been comprehensive risk research investigating the impact of gender,^(41–43) there is relatively little research assessing the role of race. The majority of US risk research in health is not designed to assess racial differences, but rather includes race as one of many demographic variables.^(44, 45) We found a significant interest in racial differences with HPV vaccine,^(46, 47) but relatively little work in seasonal influenza.⁽⁴⁸⁾ However, existing research does suggest not only that non-white identity correlates with higher perceived risk, but also that risk may be operating differently across these populations.⁽⁴⁹⁾

1.3 Q3: What is the relation between risk perception and flu vaccine behaviors for African Americans and Whites?

The relationship between perceived risk and individual behavior is complicated. Health behavior theories tend to include risk perception as one element in a causal chain that ultimately produces behavior change, but the exact function and extent of risk in this process varies widely.⁽⁴⁾ In general, the role of risk perception is moderated by the availability of effective protective measures. Leventhal suggested that individuals who perceive themselves to be at high-risk are more likely to take action if there are effective solutions available; however, without available actions, the impact of the perceived risk is nullified.⁽⁵⁰⁾ Because vaccines are widely available, many believe that increasing perceived risk would result in greater vaccine uptake.

Brewer et al. asked this very question in a meta-analysis of risk and vaccination and ultimately concluded that there is a consistently strong relation between risk perception and immunization behaviors.⁽³⁾ They found significant predictability for three cognitive constructs: susceptibility, the closely-related concept of likelihood, and severity.⁽³⁾ Furthermore, they found studies that focused on influenza vaccination to have larger effect

sizes than studies on other types of vaccination.⁽³⁾ Weinstein et al. also set out to test the predictive power of three models of risk perception on seasonal influenza vaccination.⁽⁷⁾ They concluded that perceptions of risk successfully predicted subsequent influenza vaccination, but found models that assessed “risk as feelings” to be substantially better predictors.⁽⁷⁾ In their meta-analysis on specific behaviors, Nowak et al. found differences in perceived risk between vaccinators and non-vaccinators, with non-vaccinators more likely to report low-susceptibility and the belief that influenza was not a serious health threat.⁽⁵¹⁾ Furthermore, common reasons given by survey respondents for avoiding immunization included the belief that influenza is not a serious illness (i.e., low perceived severity) and the belief that they are not personally at risk for influenza (i.e., low perceived susceptibility).⁽⁵²⁾

Other studies draw connections between pandemic and seasonal influenza. While these studies are relevant, it is important to recognize differences between seasonal flu and a pandemic. For example, Jehn and colleagues in a study in Arizona in October of 2009 found that seasonal flu was perceived as more contagious than H1N1 but that it was perceived as more important to seek medical care for H1N1 than for seasonal flu.⁽⁵³⁾ A review of pandemic influenza vaccination conducted by Bish et al. suggested that both low perceived susceptibility and low perceived severity of disease were independently associated with low vaccination intentions as well as low vaccine uptake across many studies worldwide.⁽⁴⁵⁾ A study in Arizona found evidence that emotional measures or “perceived concern” to be more predictive of precautionary action against H1N1 than the cognitive dimensions of perceived likelihood.⁽⁵⁴⁾ However, there is no clear consensus over the function of risk with pandemic flu. In a longitudinal study of the American population, risk perceptions varied over the course of the pandemic, and the single best predictor for H1N1 vaccination was previous vaccination for seasonal flu, not perceived risk.^(49, 55) Other studies have shown widespread misconceptions regarding risks related to both H1N1 and seasonal flu, with evidence that the lay public has very poor ability to assess risks.⁽⁵³⁾ We found little attention in the research literature to any differences between Whites and African Americans in the way risk perception related to vaccine behavior.

2.0 METHODS

We contracted with GfK, an international research firm, to conduct this survey. The target sample was 800 non-Hispanic White and 800 non-Hispanic African American non-institutionalized adults age 18 and over residing in the United States. To acquire the necessary representative samples, GfK targeted non-Hispanic White and non-Hispanic African American adults from its KnowledgePanel, a probability-based web panel designed to be representative of the United States. GfK uses an Address Based Sampling methodology to develop the panel. For Whites, 1,329 were sampled, resulting in 838 respondents and a completion rate of 63.1%. For African Americans, 1,599 were sampled, resulting in 819 respondents for a completion rate of 51.2%. Of the 1,657 cases that qualified for and completed the main survey, 1,643 cases were determined to be valid cases to be included in the final analyses. Participants received a cash-equivalent of \$5.

GfK provided a data file with weighting variables, which incorporate design-based weights to account for the recruitment of the panelists, as well as both panel-based and study-specific

post-stratification weights benchmarked against the Current Population Survey for 2014 with respect to demographic and geographic distributions of the population ages 18 and over. All results reported here are weighted to be nationally representative.

2.1 Measures

The survey instrument was developed based on extensive qualitative research including 28 semi-structured interviews and focus groups (9 groups; $n=91$) with African Americans and Whites. We also conducted 16 cognitive interviews in an iterative fashion with Whites and African Americans to test and clarify items. This research found racial differences in the perception of risks. Many participants dismissed seasonal flu as “no big deal.” This attitude led White participants to complacency about the vaccine, but African Americans to focus on potential side effects and low confidence in the flu vaccine. These qualitative results helped us decide to measure vaccine risk as well as disease risk and to select the emotions (worry and regret) we included in the survey.

Although demographic items included other factors, in this analysis we focused on race, ethnicity, income, education, gender, marital status, and age. Risk perception was assessed using cognitive and emotional measures of both risk of disease and risk of the vaccine itself. Cognitive measures for the disease included: “How likely are you to get the flu?” (1=not likely, 5=almost certain) and “How severe do you think the flu would be?” (1=not at all severe, 4=very severe). Cognitive measures of the vaccine risk were “How likely are you to have side effects of vaccine?” (1=not likely, 5=almost certain) and “How severe do you think the side effects would be?” (1=not at all severe, 4=very severe). Emotional measures of risk for both the disease and the vaccine assessed worry, measured by “How much would you worry about flu?” and “How much would you worry about side effects?” (1=no worry at all, 4=a great deal of worry). Similarly, the regret measures were also two items: “How much regret do you think you would feel if you did get the flu?” and “How much regret do you think you would feel if you did have side effects?” (1=no regret at all, 4=a great deal of regret). Specific to this article, vaccine behavior was measured with two items: “Did you get a flu vaccine this year?” and “If you did not get the vaccine yet, do you intend to get the vaccine?” For purposes of analysis, anyone who had not yet received the flu vaccine, including both those who said they still intended to get one and those who said they did not intend to get one, were collapsed into the group, “did not get the flu shot.” We made this decision based on CDC data suggesting that by March when this survey was in the field, most people who might get the flu shot had already done so.

Another measurement challenge we attempted to address was the problem of temporality. Does an individual assess risk differently before and after taking preventive action? This survey was in the field late enough in the flu season that most people who would take the flu vaccine had already done so, yet the vaccine was still available to late-comers. Therefore, we posed slightly different risk assessment items to each group. For example, people who reported already receiving the vaccine were asked: “Imagine you had not gotten the flu vaccine. How likely would you be to get the flu this season?” People who reported they still intended to get vaccinated were asked: “If you don’t get the flu vaccine, how likely do you

think you are to get the flu this season?” Respondents who said they did not intend to get vaccinated were simply asked: “How likely are you to get the flu this season?”

3.0 DATA ANALYSIS

Analyses proceeded in four phases. The first phase was primarily descriptive, in which sample statistics and cross-tabulations were computed for salient risk and vaccination variables for both the White and African American subsamples. The second phase addressed research question 1 and involved an assessment of the dimensionality of risk perception. Specifically, for the White and African American samples separately, three competing confirmatory factor analysis (CFA) models were evaluated: a one-factor model where all eight indicators load on a single risk factor; a two-factor model with correlated (i.e., nonorthogonal) cognitive and emotional factors, each with their four respective indicators; and a two-factor model with correlated disease risk and side effect risk factors, each with four indicators. From this information, a multi-sample CFA was conducted using the best acceptable model from the previous phases of analysis, testing the invariance of the indicator variables' loadings and intercepts across the White and African American samples. Following current best practices recommendations for structural equation modeling in general and CFA specifically,^(56, 57) CFA models were fitted in Mplus (version 7) using full information maximum likelihood estimation to accommodate missing data,⁽⁵⁸⁾ with robust corrections to test statistics to adjust for potential non-normality in the data,⁽⁵⁹⁾ and applying the previously described sample weights.⁽⁶⁰⁾ Data-model fit was assessed using an absolute fit index (standardized root mean square residual, SRMR), a parsimonious fit index (root mean square error of approximation, RMSEA), and an incremental fit index (comparative fit index, CFI). Model modification indices were also examined.

The third and fourth phases of analysis involved derived scores for the disease risk and side effect risk scales. Specifically, for the third phase of analysis, factors predicting disease risk were examined across and within race groups, while the fourth phase of analysis examined the predictive value of scores on the resulting risk factor(s) on flu vaccination within the White and African American samples, utilizing derived scores for the risk factor(s) within separate binary logistic regressions and comparing regression coefficients across race groups using asymptotic parameter difference tests. In these analyses, gender, age, income, and education were controlled within each racial group's analysis to accommodate imbalances that, without such control, could otherwise induce spurious associations between the predictors and risk outcomes.

All significance tests were conducted at a minimum .05 level; results are reported for both .05 and .01 levels where relevant.

4.0 RESULTS

4.1 Descriptive Analysis

Table I shows the unweighted demographic characteristics of the total sample and the African American non-Hispanic and White non-Hispanic samples separately. Overall, African Americans in the sample were more likely to be female, younger, less likely to be

married or living with a partner, and to have less education and income. In addition, African Americans were less likely to have received the flu vaccine, but were more likely to say they intended to receive it.

Table II shows means (and SDs) of responses to the risk perception questions for risk from the flu and risk from vaccine side effects, contrasted by race and flu shot behavior. (Note that for this and subsequent analyses those who intended to get the flu shot in the future have been combined with those who do not intend to get the shot as described above.) Two-way analyses of variance yielded η^2 (partial eta-squared) effect size estimates (as well as their statistical significance) for the main effects and interaction, where significant effect sizes are commonly gauged using .01 (small effect), .06 (medium effect), and .14 (large effect). Whites and African Americans did not, in general, perceive the risk of flu statistically significantly differently, with the exception that African Americans who got the shot indicated they would feel slightly less regret if they got the flu than Whites who got the shot. With regard to perceived side effect risk, small but significant effects indicated that African Americans were more likely to perceive risk than Whites on three of the four risk questions (likelihood, severity, and worry), with larger differences observed for those who got the shot. The small but significant interaction for regret indicates a greater regret of side effects for African Americans who got the shot than for Whites who got the shot.

4.2 Confirmatory factor analysis models to answer Q1 — What is the dimensionality of risk perception for both White and African Americans?

The correlation matrix for the risk indicators (with 95% confidence intervals) appears in Table III, and summary information for all models is provided in Table IV for the White and African American samples separately. The one-factor model where all indicators load on a single risk factor fit extremely poorly. The two-factor model with correlated emotion and cognition factors also fit poorly in the White sample, and didn't even reach convergence in the African American sample. The two-factor model with correlated disease risk and side effect risk factors, however, fit reasonably well in both samples. Modification indices further suggested two error covariances in the White sample, the first between "How much do you worry about side effects?" and "How much regret would you feel if you had side effects?", and the second between "How likely are you to get the flu?" and "How severe would the flu be." These error covariances were added to both the White and African American samples to preserve a common measurement model across groups.

The two-factor disease risk and side effect risk model (with two error covariances) was then fit to the White and African American samples simultaneously, constraining all loadings and intercepts (i.e., so-called "strong invariance"). Loading constraints ensure that equal changes in a factor precipitate equal change in a measured variable across groups, while intercept constraints ensure that equal amounts of a factor lead to equal amounts of a measure variable in each group. As is customary, and hence as is the default within Mplus, error variances and covariances, factor variances, and factor means were left free across groups.⁽⁶¹⁾ The rationale for these allowable noninvariances, as discussed in both cross-sectional⁽⁶²⁾ and longitudinal⁽⁶³⁾ modeling contexts, is twofold: (1) there is no a priori theoretical belief that the groups under consideration have equal means or (co)variances on any latent variable

(factor or error), indeed they are likely to be different across groups; and (2) the imposition of any improper cross-group constraint on these parameters would compromise the ability to assess the items' strong invariance across groups⁽⁶⁴⁾. As seen at the bottom of Table IV, the fit of this constrained model was also quite acceptable; for both samples the standardized loadings for indicators of both factors ranged from .53 to .88, with a median value of .79. For a simple scale constructed of the four disease risk items weighted equally (after proportionally rescaling the 5-point likelihood item to 4 points), internal consistency reliability is $\alpha=.84$ and $\alpha=.82$ for the White and African American samples, respectively. Similarly, for a simple scale constructed of the four side effect risk items weighted equally (after proportionally rescaling the 5-point likelihood item to 4 points), internal consistency reliability is $\alpha=.84$ and $\alpha=.83$ for the White and African American samples, respectively. These disease risk and side effect risk scale scores are used in the analyses to follow.

4.3 Demographic predictors of disease risk and side effect risk for White and African Americans to answer Q2 — Were risk perceptions of White and African American populations different and how were sociodemographic characteristics related to risk for each group?

Mean differences among the White and African American males and females, in both disease risk and side effect risk separately, were assessed using a 2×2 (race $\times$ gender) analysis of covariance controlling for age, education, and income level; these covariates were selected because of their potential for imbalance across the ethnicity and gender groups as well as their potential relation to risk perception (i.e., risk perception may change with age, education, and/or socioeconomic status). With regard to disease risk, for which age was the only statistically significant covariate ($p<.001$, $\eta^2=.026$; education, $p<.925$, $\eta^2=.000$; income, $p<.135$, $\eta^2=.001$), evidence of a small-to-medium ($\eta^2=.018$) gender main effect was detected ($p<.001$), with the covariate-adjusted scale mean for males and females being 2.01 and 2.23, respectively. The race main effect was also statistically significant ($p=.046$), though quite small ($\eta^2=.002$), with the covariate-adjusted scale means for Whites and African-Americans being 2.16 and 2.08, respectively. The race $\times$ gender interaction was not statistically significant ($p=.077$, $\eta^2=.002$). As for side effect risk, for which age ($p<.001$; $\eta^2=.011$) and education ($p<.001$, $\eta^2=.009$) were both statistically significant covariates (income, $p<.860$, $\eta^2=.000$), evidence of a small ($\eta^2=.010$) gender main effect was detected ($p<.001$), with the covariate-adjusted scale mean for males and females being 1.85 and 2.01, respectively. The race main effect was also statistically significant ($p<.001$) and small ($\eta^2=.011$), with the covariate-adjusted scale means for Whites and African-Americans being 1.83 and 2.02, respectively. The race $\times$ gender interaction was again not statistically significant ($p=.136$; $\eta^2=.001$).

Expanding upon the above analyses, within the White and African American samples separately, disease risk and side effect risk scores were treated as outcomes within multiple regression analyses using gender, age, education, and income as predictors. The purpose was primarily to examine the differential salience of these predictors to the risk outcomes. With regard to disease risk, the explained variance in disease risk for Whites was 4.2% (i.e., $R^2=.042$), and two predictors were statistically significant: gender ($p=.010$, $\beta=.088$; women had higher perceived disease risk), and age ($p<.001$, $\beta=.179$; higher age, higher perceived

disease risk). Neither education nor income were statistically significant predictors of disease risk for the White sample. For the African American sample, the explained variance in disease risk was 4.4% (i.e., $R^2=.044$), with the same two predictors statistically significant: gender ($p<.001$, $\beta=.181$; women had higher perceived disease risk), and age ($p=.001$, $\beta=.123$; higher age, higher perceived disease risk). Comparing slopes across race groups for predicting disease risk, no statistically significant differences of the predictors' explanatory value across the African American and White samples was detected.

Meanwhile, for side effect risk, the explained variance for the White sample was 4.0% (i.e., $R^2=.044$), with three predictors statistically significant: age ($p=.001$, $\beta=-.116$; higher age, lower perceived side effect risk), education ($p=.004$, $\beta=-.106$; more education, lower perceived side effect risk), and income ($p=.024$, $\beta=-.084$; higher income, lower perceived side effect risk). Gender was not statistically significant for the White group. For the African American sample, the explained variance in side effect risk was 3.4% (i.e., $R^2=.034$), with three predictors statistically significant: gender ($p<.001$, $\beta=.141$; higher perceived side effect risk for females), age ($p=.007$, $\beta=-.096$; higher age, lower perceived side effect risk), and education ($p=.029$, $\beta=-.085$; higher education, lower perceived side effect risk). Income was not statistically significant for the African American sample. Comparing slopes across race groups showed the predictive value of income differed statistically significantly across groups, with income being a significantly stronger predictor of perceived side effect risk for the White sample.

Finally, we also conducted combined-sample multiple regressions predicting perceived disease risk and side effect risk with the same demographic predictors (gender, age, income, education) and, in addition, included race as a predictor. The purpose of this final analysis was to determine whether the race differences observed in bivariate analysis remained when demographic variables were controlled. For perceived disease risk, race was not a statistically significant predictor ($p=.078$) after controlling for the covariates. However, for side effect risk, African Americans remained statistically significantly ($p<.001$) more likely to perceive risk from the vaccine than Whites even after the other demographic variables were controlled.

4.4 Logistic regression models to answer Q3 — What is the relation between risk perception and flu vaccine behaviors for African Americans and Whites?

Scores for the disease risk and side effect risk factors were mean-centered within each sample and their product was formed, entering the original risk main effects and interaction into a binary logistic regression within each race group, along with a preliminary block of four demographic covariates – gender, age, income, and education. The disease $\times$ side effect risk interaction was included as a means of assessing whether the level of perceived risk for one factor was dependent upon, or at least synergistically related to, the level for the other. As per Aiken and West (1991), the interaction term was left in the model even if it was not statistically significant, so as not to induce potential bias in the assessment of the disease risk and side effect risk main effects.⁽⁶⁵⁾ Results are shown for the risk main effects and interaction in Table V, above and beyond the covariates. Regarding the White sample, for which age was the only significant control variable (older individuals are more likely to be

vaccinated), results revealed that the probability of vaccination increased with perceived disease risk ($p<.001$), decreased with perceived side effect risk ($p<.001$), and was a function of the interaction of disease and side effect risk ($p=.007$). In terms of predicting who would and would not get a flu vaccine, a model with only covariates classified 53.9% of the White sample correctly; the addition of the three risk predictors increased this markedly to 85.9%. In the African American sample, for which age was also the only statistically significant control variable, the probability of flu vaccination also increased with perceived disease risk ($p<.001$) and decreased with perceived side effect risk ($p<.001$), although no statistically significant interaction between disease and side effect risk was detected ($p=.297$). In terms of predicting who would and would not get a flu vaccine, a model with only covariates classified 62.5% of the African American sample correctly; the addition of the three risk predictors increased this to 79.2%. Separate statistical tests of predictor coefficients across the White and African American samples revealed that the effect of side effect risk was statistically significantly stronger within the White sample ($p=.002$), and the interaction was also statistically significantly stronger within the White sample ($p<.001$). The effect of disease risk on flu vaccination was not statistically significantly different across the White and African American samples.

To help to interpret the model differences across the White and African American samples, predicted probabilities were derived from the respective logistic regression models for the combination of the disease risk and side effect risk scale values from 1 (no concern) to 4 (severe concern), while setting values of the four demographic covariates at the median value across both races. Predicted probabilities appear in Table VI. As an example, for a scale value of 3 for both disease and side effect risk, the predicted probability of flu vaccination for the White sample is .25, while for the African American sample, it is .61. As can be seen in the table, the most interesting discrepancies occur at the highest levels of perceived disease risk. To illustrate, when perceived disease risk is at the highest level of 4, for the White sample an accompanying perception of high side effect risk greatly reduces the predicted probability of vaccination. For the African American sample, however, increased perception of side effect risk does comparatively little to reduce the predicted probability of vaccination when perceived disease risk is high.

5.0 DISCUSSION

Any interpretation of these results must take into account the context of the research. The sample was adults who were making a decision about the seasonal flu vaccine for themselves. If these adults were making a decision for their children or if the decision was about an emergency vaccine rather than a routine one, the results might be quite different. Overall, these results confirm the importance of risk perception in the flu vaccine decision-making process for both African Americans and Whites. Those who had gotten the flu shot reported much greater risk of disease and much less risk of the vaccine than those who did not get the vaccine. Significant differences also were found between the races in their perceptions of risk. African Americans and Whites were similar in their assessment of risk from the disease but African Americans were more likely to report higher perceived risks of the vaccine. These findings are not surprising given all the evidence about African Americans' lack of trust of the medical establishment and the historical legacy of the

Tuskegee Syphilis Study. Most flu vaccine campaigns focus on the risk from the disease and minimize the issue of risks from the vaccine. These results suggest that both should be addressed and perceived vaccine risks should be specifically countered in campaigns targeting African American populations.

Our first research question addressed the dimensionality of risk perception. Recent research led us to expect that we would confirm the importance of both cognitive and emotional dimensions of risk perception, but we did not. At least in the context of seasonal flu vaccine, evidence of separate cognitive and emotional dimensions of risk perception was not found. Perhaps, because seasonal flu is more routine, the emotional reactions are not activated the way they may be in an emergency situation. What we did find was that understanding risk perception in the flu vaccine context requires considering both disease risk and vaccine risk, and that both disease and vaccine risks can be measured with similar items, allowing for comparisons between the two.

Our second research question asked if risk perceptions of White and African American populations differ and what sociodemographic characteristics were related to risk for each group. Risk perceptions did differ for the two groups. For perception of disease risk for the White group, gender, age, and income were significantly related while only gender and age were significantly related to disease risk for African Americans. The direction of these relations was the same, i.e., women reported more risk of the disease than men for both Whites and African Americans and the older the age, the greater risk of the disease for both groups. Differences also were found for the perceptions of risk from side effects of the vaccine. For Whites, age had the only significant relationship with vaccine risk but for African Americans, age as well as gender and education were significantly related. In this case of vaccine risk, the higher the age, the lower the perception of vaccine risk for both groups and for African Americans, women feared the vaccine more than men and the higher the age and education level, the lower the perceived risk of the vaccine.

Our final research question asked if there were differences between African Americans and Whites in the way risk perception was related to vaccine acceptance. In general, when we isolated risk perception, it was significantly related to flu vaccination behavior. Future analyses will determine what happens when other significant concepts such as trust, social norms, and vaccine hesitancy are included in the models. There were differences between Whites and African Americans in the way risk perception related to vaccine behavior. For Whites, as disease risk increased, vaccine acceptance increased; as vaccine risk increased, acceptance decreased, but there also was a significant interaction effect. Whites with the highest levels of perceived disease risk were much less likely to vaccinate if they also had a high perceived risk of side effects. For the African American sample, however, increased side effect risk does comparatively little to reduce the probability of vaccination when perceived disease risk is also high.

One implication for flu vaccine campaigns is very clear. Messages must address both kinds of risk, disease and vaccine. Since flu vaccination is routine and may not stimulate the kind of emotional reactions that an emergency does, the public may be more concerned about vaccine risk than disease risk. Therefore, to ignore it is not advisable. The trust of the

American people in government is at an all-time low, which also feeds into fear of vaccines. (66) Our qualitative work demonstrated that most people have very limited understanding of the way vaccine recommendations are determined and how vaccines are made and distributed. Perhaps increasing knowledge about the process and its many contributing organizations may decrease perception of risk from the vaccine.

The conclusions about risk perception that can be reached from this study are limited because the only context examined was seasonal flu vaccination and the design was cross-sectional. In this study we have described the differences between African American and White risk perceptions regarding flu vaccinations and the sociodemographic differences in risk perceptions between the two groups. We still need to learn more about the role risk plays in vaccine decision-making and why it differs between the races. The critical next step in research is to conduct longitudinal studies where risk perception is added to other constructs that are empirically linked to vaccine behavior, to understand the complex decision making process around seasonal flu vaccination.

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Table I

Sample Demographics and Flu Vaccination Behavior and Intentions *

	Overall US Sample (N=1643) %	White Non-Hispanic (N=834) %	A.A. Non-Hispanic (N=809) %	Chi-Square Test or t-test (Sig.)
Sex				
Male	47.7	50.5	44.7	.011
Female	62.3	49.5	55.3	
Age				
18–29	16.4	14.9	17.9	.007
30–44	18.9	18.6	19.3	
45–59	29.0	27.0	31.1	
60+	35.7	39.6	31.6	
Mean Age(SD)	51.2 (17.2)	52.7 (17.8)	49.7 (16.4)	<.001
Marital Status				
Married/Living with partner	54.3	65.9	42.3	<.001
Widowed/Divorced/Separated	20.4	16.5	24.4	
Never married	25.3	17.5	33.4	
Education				
Less than high school	7.4	5.6	9.1	<.001
High School	31.2	31.4	30.9	
Some College	29.8	26.1	33.5	
Bachelor' Degree or higher	31.7	36.8	26.5	
Income				
Less than \$20,000	19.8	11.9	28.1	<.001
\$20,000 to \$39,999	20.3	17.0	23.6	
\$40,000 to \$84,999	32.6	34.2	30.9	
\$85,000 or more	27.3	36.9	17.4	
Vaccine Behavior & Intentions				
Got flu shot	49.0	53.4	44.4	<.001
Did not get flu shot	51.0	46.6	55.6	
Did not get flu shot but intend to	13.1	9.7	16.8	

* All numbers and percentages are unweighted

Table II

Mean Differences on Perceived Risk from the Flu and Flu Vaccine Side Effects

	White No shot Mean (SD)	White Got shot Mean (SD)	A.A. No shot Mean (SD)	A.A. Got shot Mean (SD)	Race	Shot η^2	Race $\times$ Shot η^2
PERCEIVED RISK FROM FLU							
How likely are you to get the flu? ¹	1.71 (0.85)	2.79 (1.04)	1.75 (0.97)	2.86 (1.17)	$\eta^2=.001$ $F=1.010$ $d\leq 1, 1643$	$\eta^2=.225^{**}$ $F=478.181$ $d\leq 1, 1643$	$\eta^2=.000$ $F=0.104$ $d\leq 1, 1643$
How severe would the flu be? ²	1.87 (0.80)	2.68 (0.81)	1.90 (0.81)	2.54 (0.92)	$\eta^2=.001$ $F=1.666$ $d\leq 1, 1627$	$\eta^2=.157^{**}$ $F=302.797$ $d\leq 1, 1627$	$\eta^2=.002$ $F=3.981$ $d\leq 1, 1627$
How much do you worry about the flu? ²	1.37 (0.64)	2.45 (0.95)	1.42 (0.68)	2.40 (1.01)	$\eta^2=.000$ $F=0.012$ $d\leq 1, 1642$	$\eta^2=.277^{**}$ $F=628.660$ $d\leq 1, 1642$	$\eta^2=.001$ $F=1.437$ $d\leq 1, 1642$
How much regret would you feel if you got the flu? ²	1.54 (0.79)	2.95 (1.08)	1.58 (0.85)	2.75 (1.10)	$\eta^2=.002$ $F=2.796$ $d\leq 1, 1632$	$\eta^2=.306^{**}$ $F=721.047$ $d\leq 1, 1632$	$\eta^2=.004^*$ $F=6.500$ $d\leq 1, 1632$
PERCEIVED RISK FROM VACCINE SIDE EFFECTS							
How likely are you to have side effects from the flu shot? ¹	2.46 (1.27)	1.47 (0.78)	2.63 (1.35)	1.80 (0.96)	$\eta^2=.013^{**}$ $F=20.701$ $d\leq 1, 1631$	$\eta^2=.138^{**}$ $F=260.776$ $d\leq 1, 1631$	$\eta^2=.001$ $F=1.892$ $d\leq 1, 1631$
How severe would side effects be? ²	1.93 (0.88)	1.32 (0.59)	2.05 (0.98)	1.73 (0.88)	$\eta^2=.024^{**}$ $F=39.150$ $d\leq 1, 1624$	$\eta^2=.070^{**}$ $F=121.816$ $d\leq 1, 1624$	$\eta^2=.007^{**}$ $F=11.647$ $d\leq 1, 1624$
How much do you worry about side effects? ²	1.92 (1.00)	1.30 (0.55)	2.07 (1.05)	1.61 (0.80)	$\eta^2=.017^{**}$ $F=27.906$ $d\leq 1, 1633$	$\eta^2=.085^{**}$ $F=152.341$ $d\leq 1, 1633$	$\eta^2=.002$ $F=2.933$ $d\leq 1, 1633$
How much regret would you feel if you had side effects? ²	2.52 (1.11)	1.65 (0.78)	2.35 (1.12)	1.90 (0.92)	$\eta^2=.000$ $F=0.506$ $d\leq 1, 1631$	$\eta^2=.097^{**}$ $F=174.501$ $d\leq 1, 1631$	$\eta^2=.011^{**}$ $F=17.611$ $d\leq 1, 1631$

All analyses are weighted.

*
 $p<.05$;**
 $p<.01$ ¹Mean on 5-point scale with 5='Almost certain'²Mean on 4-point scale with 4='Very Severe' or 'A great deal of worry' or 'A great deal of regret'

Table III

Correlations for risk indicators for White sample (above diagonal) and African American sample (below diagonal), with 95% confidence interval lower and upper bounds beneath

	1	2	3	4	5	6	7	8
1. How likely are you to get the flu?		.56**[.51,.60]	.60**[.56,.64]	.48**[.42,.53]	-.16** [-.22,-.09]	-.09*[-.16,-.02]	-.09*[-.16,-.02]	-.18**[-.24,-.11]
2. How severe would the flu be?	.48**[.42,.53]		.61**[.57,.65]	.53**[.48,.58]	-.11**[-.18,-.04]	-.01[-.08,.06]	-.05[-.12,.02]	-.11**[-.18,-.04]
3. How much do you worry about the flu?	.58**[.53,.62]	.46**[.40,.51]		.69**[.65,.72]	-.20**[-.27,-.13]	-.11**[-.17,-.04]	-.09**[-.16,-.02]	-.17**[-.24,-.10]
4. How much regret would you feel if you got the flu?	.55**[.50,.59]	.48**[.42,.53]	.66**[.62,.70]		-.33**[-.38,-.26]	-.24**[-.30,-.17]	-.22**[-.29,-.16]	-.23**[-.29,-.16]
5. How likely are you to have side effects from the flu shot?	-.08*[-.15,-.01]	.01[-.07,.08]	-.10**[-.17,-.03]	-.19**[-.25,-.12]		.73**[.70,.76]	.66**[.62,.70]	.46**[.40,.51]
6. How severe would side effects be?	-.05[-.12,.02]	.11**[.04,.18]	.03[-.04,.10]	-.00[-.07,.07]	.62**[.58,.66]		.70**[.66,.73]	.46**[.40,.51]
7. How much do you worry about side effects?	-.02[-.09,.05]	.04[-.03,.11]	.07[.00,.14]	-.02[-.09,.05]	.65**[.61,.69]	.64[.59,.68]		.55**[.50,.59]
8. How much regret would you feel if you had side effects?	-.09*[-.16,-.02]	-.00[-.07,.07]	-.03[-.10,.04]	-.01[-.08,.06]	.46**[.40,.51]	.44**[.38,.51]	.51**[.46,.56]	

Table IV
Summary of fit of CFA models within and across White and African American samples

	χ^2	df	SRMR	RMSEA	CFI
<i>One-factor model</i>					
White	1225.155	20	.202	.270	.423
African American	663.071	20	.208	.201	.425
<i>Two-factor model, emotional & cognitive</i>					
White	1341.161	19	.204	.290	.367
African American	---	---	---	---	---
<i>Two-factor model, disease risk & side effect risk</i>					
White	133.604	19	.053	.085	.945
African American	69.606	19	.042	.058	.955
<i>Two-factor model, disease risk & side effect risk, with two error covariances</i>					
White	92.214	17	.050	.073	.964
African American	63.689	17	.041	.059	.958
<i>Multisample two-factor model, disease risk & side effect risk, with error covariances</i>					
	173.049	46	.051	.058	.958

Note: Model χ^2 , and the RMSEA and CFI derived from it, included nonnormality adjustments

Table V

Prediction of flu vaccination from risk factors

Predictor	b	S.E.	Wald	df	p	exp(b)
<i>White</i> ($\chi^2=588.909$, $-2LL=555.515$, Cox & Snell $R^2=.510$, Nagelkerke $R^2=.680$)						
Disease Risk	2.444	.194	158.087	1	<.001	11.524
Side Effect Risk	-1.783	.186	91.633	1	<.001	.168
Interaction	-.570	.210	7.362	1	.007	.565
<i>African American</i> ($\chi^2=401.034$, $-2LL=663.087$, Cox & Snell $R^2=.398$, Nagelkerke $R^2=.538$)						
Disease Risk	2.098	.165	162.574	1	<.001	8.150
Side Effect Risk	-1.246	.157	63.345	1	<.001	.288
Interaction	.195	.187	1.089	1	.297	1.216

Note: Disease Risk and Side Effect Risk predictors in models are group mean-centered. The interaction is the product of the mean-centered Disease Risk and Side Effect Risk variables. The covariates of gender, age, income, and education are also in the models.

Table VI
Predicted probabilities from logistic regression models for White (W) and African American (AA) samples

<i>Disease Risk Scale Points</i>					
	1	2	3	4	
<i>Side Effect Risk</i>	W/AA	W/AA	W/AA	W/AA	W/AA
<i>Scale Points</i>					
4	.00/.00	.01/.04	.03/.35	.10/.86	
3	.01/.02	.05/.14	.25/.61	.66/.94	
2	.03/.06	.23/.36	.76/.82	.97/.97	
1	.08/.23	.62/.66	.97/.93	1.00/.99	