Opposing role of trust as a modifier of COVID-19 vaccine uptake in an indigenous population

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Abstract: Native Hawaiians and other Pacific Islanders (NHPIs) are disproportionately impacted by COVID-19 and remain significantly under-vaccinated. To understand vaccine hesitancy, we surveyed 1,128 adults residing in a region with one of the lowest vaccination rates in Hawai'i during our COVID-19 testing program. Probit regression analysis revealed that race/ethnicity was not directly associated with the probability of vaccine uptake. Instead, a higher degree of trust in official sources of COVID-19 information increased the probability of vaccination by 20.68%, whereas a higher trust in unofficial sources decreased the probability of vaccination by 12.49% per unit of trust. These results reveal a dual and opposing role of trust in vaccine uptake. Interestingly, NHPIs were the only racial/ethnic group to exhibit a significant positive association between trust in and consumption of unofficial sources of COVID-19 information, which explains the vaccine hesitancy observed in this indigenous population. These results offer novel insight relevant to COVID-19 mitigation efforts in minority populations.

This brief report file includes:

Table 1

Table 2

Introduction

The stagnating vaccination rates against SARS-CoV-2 and increased vulnerabilities to the more transmissible Delta and other emerging variants (*i.e.* Omicron) portend a resurgence of COVID-19 throughout the country[1], especially among vaccine-hesitant populations[2]. Native Hawaiians and other Pacific Islanders (NHPIs) comprise 25% of Hawaiʻi's population, yet currently account for 38% of all COVID-19 cases[3], intensifying their pre-pandemic health disparities[4,5]. Delta-driven surges in cases recently threatened Hawaiʻi's healthcare system, with the majority (~90%) of COVID-19 hospitalizations arising among unvaccinated individuals and disproportionately impacted the NHPI population who remain under-vaccinated[6]. Therefore, implementing public health policies aimed at accelerating vaccine uptake and increasing coverage are urgently needed.

To inform such policies, identifying contributors to vaccine hesitancy is a requisite. Although prior studies of other populations demonstrated that vaccine hesitancy associates with distrust and misinformation[7,8], none have yet reported whether these factors account for the under-vaccinated rates in indigenous populations, including NHPIs. Additionally, the mechanism by which such factors might influence COVID-19 vaccine uptake remains unclear. Herein, we show that racial/ethnic differences in trust between sources of COVID-19 information coupled with the level of consumption of such information strongly correspond to vaccine uptake. Despite our focus on NHPIs, these results confirm social factors previously implicated in vaccine hesitancy and offer novel insight into how these factors interact to influence vaccine uptake that will be useful for public health policy in other similarly vulnerable minority populations in the US.

Methods

Recruitment strategy and survey instrument

A community in Hawaiʻi with the highest density of Native Hawaiians per capita (Waiʻanae, Oʻahu) enrolled in an ongoing COVID-19 testing program were consented to participate in the National Institutes of Health (NIH) Rapid Acceleration of Diagnostics in Underserved Populations (RADx-UP) survey, which was disseminated by a unique partnership at the University of Hawaiʻi and five federally qualified health centers in the state called the Pacific Alliance Against COVID-19 (PAAC). This survey included demographic data (*e.g.*, self-reported age, gender, race/ethnicity) and vaccination status. The survey also included self-reported trust of a source to provide correct information about COVID-19 (herein referred to as *trust*), the use or reliance on a source for information about COVID-19 (herein referred to as *consumption*), and other health-related behaviors, with a 66% completion rate of these metrics. These metrics have been vetted and used by the NIH RADx-UP initiative via a consortium of over 100

participating sites throughout the country[9]. Survey data were collected from June to August 2021, after COVID-19 vaccines were widely available for adults and before state mandates for vaccination were issued. As summarized in Table 1, the proportion of racial/ethnic groups among the total of 1,128 adult respondents of this survey were representative of the Waiʻanae population based on US Census data 2020 (Zipcode: 96792). This study was approved by the Waiʻanae Coast Comprehensive Health Center Institutional Review Board.

Statistical analysis of survey data and probabilistic model

Degree of *trust* and frequency of *consumption* were obtained for a variety of sources, including the federal and local government, healthcare providers, TV, radio, print or online news, friends, family members and other acquaintances, and contacts on social media. These sources were categorized as either *official* or *unofficial*. Official sources included government, healthcare providers, and traditional channels of communication such as TV, radio, and print news; unofficial sources included social media channels, friends, family, acquaintances, and faith leaders. Trust in official and unofficial sources were measured on a Likert scale, the average values of which are shown in Table 1 and stratified by different groups as indicated. Similarly, the frequency of consumption of COVID-19 information from official or unofficial sources were measured on a Likert scale and the average values are shown in Table 1. Ordinary least squares (OLS) estimations for average trust in official (or unofficial) sources and frequency of consumption of information from official (or unofficial) sources were performed. Estimations are presented in Table 2a,c for the indicated demographic variables, with the estimators for each racial/ethnic group calculated in comparison to whites, males in comparison to females, and education level in comparison to 'not completed high school.' Table 2b represents a Probit regression for estimating vaccination status as a function of trust in official and unofficial sources. A similar estimator for demographic coefficients is presented. The accuracy of the Probit regression was measured as the percentage of correctly predicted vaccination outcomes, resulting in 70.5% correctly predicted outcomes (31.8% of overall outcomes when adjusted for the most frequent outcomes). These analyses were completed using R Statistical Software version 4.0.5 (R Project for Statistical Computing) within RStudio statistical software version 1.3.1073 (RStudio).

Results

Opposing role of trust in modifying vaccine hesitancy

To determine the extent to which trust influenced vaccine uptake, we first examined perceptions of trust in official or unofficial sources of COVID-19 information as well as the frequency of consumption of COVID-19 information from official or unofficial sources. Data was stratified based on vaccination status, age, racial/ethnic group, and level of education. We observed that compared to unvaccinated individuals, those vaccinated reported a higher degree of trust in official sources of COVID-19 information concomitant with

more frequent consumption of this information (Table 1). These results implicated trust and consumption of COVID-19 information as co-dependent modifiers of vaccine uptake where the choice regarding vaccination varied depending on the frequency of consumption of COVID-19 information from official or unofficial sources. Indeed, we observed a significant positive linear relationship between the frequency of consumption of COVID-19 information from either official or unofficial sources and degree of trust in those sources, respectively (R^2=0.42, p<0.001, 95% CI = (0.46, 0.699) and R^2=0.17, p<0.001, 95% CI = (0.089, 0.284), respectively; Table 2a,c). By comparing vaccination status and trust, we found a significant positive association between uptake of the COVID-19 vaccine and degree of trust in official sources (p<0.001, 95% CI = (0.415, 0.651); Table 2b). In contrast, we observed a significant negative association between vaccine uptake and degree of trust in unofficial sources (p<0.001, 95% CI = (-0.449, -0.195); Table 2b). These results indicate that individuals with a higher degree of trust in official sources of COVID-19 information were more receptive to receiving the COVID-19 vaccine, whereas those with a higher degree of trust in unofficial sources were less receptive, revealing an opposing role of trust in vaccine uptake. To highlight this opposing role, we estimated the probability of vaccine uptake using the marginal effect of the Probit regression model[10]. We computed that, on average, increasing one unit of trust (as on the Likert scale) in *official* sources increases the probability of vaccination by 20.68%, whereas an increase of one unit of trust in *unofficial* sources decreases the probability of vaccination by 12.49%. This result indicated that perceived trust indeed plays an opposing role in modifying vaccine uptake, the outcome and degree to which was dependent on the source of COVID-19 information.

Race/ethnicity alone is not a modifier of vaccine uptake in NHPIs

We next examined other potential modifiers of vaccine hesitancy. Given the significant racial/ethnic differences in vaccine uptake, especially among Native Hawaiians in Hawai'i who remained under-vaccinated[11], we expected to observe race/ethnicity as a modifier. Surprisingly, with the only exception among the Other racial/ethnic group, we observed that race/ethnicity alone was not directly associated with the probability of vaccine uptake (p=0.92, NHPI, and p=0.16, Asian; Table 2b). Instead, among NHPIs, our data indicated that trust in official and unofficial sources along with race/ethnicity modify vaccine uptake. Compared to whites, NHPIs reported a higher degree of trust in unofficial sources and more frequent consumption of unofficial COVID-19 related information (p=0.007, 95% CI = (-0.363, -0.0591) and p=0.01, 95% CI = (-0.407, -0.0562), respectively; Table 1). Interestingly, we observed a significant positive association between the degree of trust in and frequency of consumption of COVID-19 information from unofficial sources only among NHPIs relative to whites (p=0.029, 95% CI = (0.294, 0.414); Table 2c). While trust in official, government sources of information observed was anticipated based on historical and present-day political, social, and structural discrimination of NHPIs[5,6,12], the significantly higher degree of trust in unofficial sources of COVID-19 information was not expected.

Age, gender, and education level as co-modifiers of vaccine uptake

Finally, we found that overall, age had a weak effect on the association between the degree of trust and consumption of COVID-19 information for both official and unofficial sources ($p<0.02$, 95% CI = (0.000132, 0.00734) and $p<0.03$, 95% CI = (0.0002, 0.00797), respectively; Table 2a,c) and that males had a higher degree of trust and consumption of official, but not unofficial, sources of information relative to females ($p<0.01$, 95% CI = (0.22205, 0.235) and $p=0.51$, respectively; Table 2a,c). In addition, we observed that the level of education was not a contributor to the degree of trust in official or unofficial sources (Table 2a,c). However, the level of education was significantly associated with vaccine uptake independent of other factors relative to individuals with no high school diploma ($p=0.06$, 95% CI = (0.165, 0.986), $p<0.001$ 95% CI = (0.31, 1.40), and $p<0.001$, 95% CI = (0.710, 1.57) for college level, Bachelor's, and other advanced degrees, respectively; Table 2b), indicating that education may act as a modifier of vaccine hesitancy. Indeed, when accounting for education level, we no longer observed a significant association between the degree of trust and frequency of consumption of COVID-19 information from official sources among NHPIs ($p=0.30$; Table 2a). These results coupled with the negative association between the degree of trust in unofficial sources and vaccine uptake ($p=0.03$, 95% CI = (-0.449, -0.195); Table 2c), indicates that race/ethnicity is necessary but insufficient alone as a modifier of vaccine hesitancy among NHPIs and instead must be considered along with education, trust and consumption of COVID-19 information. Therefore, accounting for these covariates, the lower vaccine uptake among NHPIs appears to be primarily driven by their higher degree of trust in and consumption of COVID-19 information from unofficial sources.

Discussion

Altogether, our data offers a model for how trust in and consumption of COVID-19 information from distinct sources modifies vaccine uptake, highlighting novel opportunities for addressing vaccine hesitancy in vulnerable populations. Importantly, we show that trust has an opposing role in modifying vaccine uptake, which is highly dependent on the source of information. Our finding that trust in official sources of information, the degree of which is correlated with the frequency of consumption of such information, is a positive modifier of vaccine uptake highlights the importance of effective government communication strategies. Interestingly, the negative relationship between trust in unofficial sources and vaccine uptake might indicate that such sources are actively discouraging vaccination, to potentially include factors such as the spread of misinformation that has previously been implicated in contributing to reduced vaccine uptake[8,13]. Further investigation to confirm the specific constituents that comprise unofficial sources of information is therefore expected to reveal additional insight into vaccine hesitancy. As Delta-driven surges

threaten other states[1], this becomes an ever more pressing priority for COVID-19 mitigation policies, which our data suggest should incorporate interventions that fosters trust in official sources of COVID-19 information and promotes health literacy.

5   As our recruitment strategy was restricted to the Waiʻanae community, the predominant racial/ethnic group in our dataset was Native Hawaiians (58%). Although generally, the proportion of major racial/ethnic groups such as Asians and Whites closely resembled the composition of the Waiʻanae community, our dataset comprised a small number of individuals from non-Native Hawaiian minority racial/ethnic groups. Indeed, only 3% of Pacific Islanders categorized within NHPIs appear in our dataset, and Other racial/ethnic

10   groups that are considered minorities in Hawaiʻi (*e.g.*, Hispanics, Blacks, and Native Americans) collectively make up just 7%, aligning to the composition in the state of Hawaiʻi. Given this limitation, we continued to apply the 1997 US Office of Management and Budget reclassification of Native Hawaiians under the NHPI category and combined racial/ethnic minorities under Other. We recognize the importance of disaggregating data to measure racial/ethnic disparities in COVID-19[11,14]. Indeed, disaggregated data of

15   vaccination rates among NHPIs revealed that while PIs are covered at the same level representative of their population (4%), NHs are currently under-vaccinated at 14% (versus 21% of the population)[3]. Coupled with the higher transmissibility of the Delta variant, this low vaccination coverage contributed to the over-representation of NHs in infections, accounting for 29% of all COVID-19 cases at the time of this writing, while the representative vaccination coverage among PIs was associated with a significant decline in

20   COVID-19 among this population[3]. Therefore, given that our dataset largely comprised NHs, we are confident that the aggregated data of NHPIs well represents the NH population and is relevant to COVID-19 vaccine hesitancy. However, any variability of the metrics collected among PIs will be masked by that of NHs, and the low sample size of other racial/ethnic minority groups represented precluded a powered disaggregated analysis.

25

Another limitation of this study is that our model does not account for other factors such as income, household size, job type/sector, risk of COVID-19 exposures, pre-existing medical conditions, *etc.*, that may influence vaccine uptake. Indeed, a recent study of a limited number of patients with neurological disorders in Hawaiʻi examined over 30 sociodemographic variables and medical comorbidities and found

30   that among NHPI patients, a positive depression screen reduced the odds of vaccine acceptance[15]. Thus, we determined the accuracy of our model that considered age, gender, education, and trust and consumption of COVID-19 information by calculating the ratio of correctly predicted outcomes in vaccine uptake over our total number of observations (n=1,128). We found that our Probit model correctly predicted 70.5% of overall outcomes with just these five factors alone. However, additional studies to examine the degree to

35   which other potential modifiers might improve the accuracy of our model are warranted.

The recent, amplified resurgence of COVID-19 in Hawaiʻi underscores the adverse consequences of long-standing yet unaddressed social inequities in its indigenous population with significant externalities to all, highlighting the wide-reaching benefits of establishing health equity. Results of our study offer insight into the nuances of vaccine hesitancy with which community and culturally relevant interventions may be tailored to reduce racial/ethnic disparities of COVID-19.

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Data and materials availability

All data used for this project will be available de-identified as approved by the Waianae Coast Comprehensive Health Center Institutional Review Board.

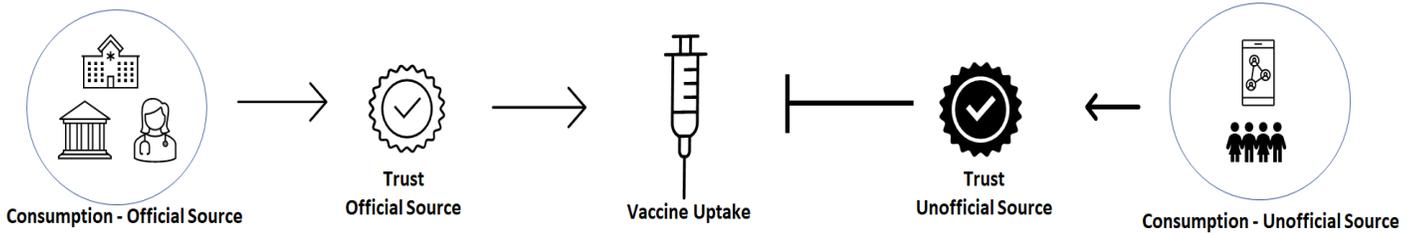| Demographics and Survey Responses	Overall, N = 1128		Vaccinated, N=639		Unvaccinated, N=489		NHPI, N=696		Asian, N=198		White, N=147		Other, N=87	
Gender	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
Male	709	63.0%	408	64%	300	61%	451	65%	124	63%	93	63%	40	46%
Female	416	37.0%	229	36%	187	38%	243	35%	72	36.00%	54	37%	47	54%
Other and prefer not to answer	2	0.20%	2	0.30%	0	0	0	0%	2	1%	0	0%	0	0%
Education	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
9th to 12th grade, no diploma	55	4.90%	18	2.80%	36	7.60%	42	6%	1	1%	6	4.10%	5	5.70%
High school graduate or GED completed	410	36.0%	165	26%	245	50%	324	47%	38	19%	16	11%	32	37%
Some college level/ Technical / Vocational degree	269	24.0%	159	25%	110	22%	169	24%	53	27%	26	18%	21	24%
Bachelor's degree	175	16.0%	122	19%	53	11%	77	11%	47	24%	36	24%	15	17%
Other advanced degree (Master's, Doctoral degree)	220	19.0%	175	27%	45	9.20%	84	12%	59	30%	63	43%	14	16%
Trust - Official Source of COVID-19 Information[1]	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
U.S. Government	1.18	1.10	1.43	1.12	0.85	0.98	1.11	1.06	1.4	1.14	1.3	1.2	1.02	1.06
U.S. Coronavirus task force	1.32	1.17	1.56	1.21	1.00	1.04	1.26	1.13	1.49	1.21	1.46	1.29	1.09	1.14
Doctor or health care provider	1.92	1.23	2.07	1.24	1.73	1.18	1.89	1.22	2.05	1.21	1.92	1.28	1.89	1.21
News on the radio, TV, online, or in newspapers	1.17	1.05	1.37	1.96	0.91	0.90	1.17	1.05	1.29	1.05	1.14	1.09	0.99	1.03
Average overall	**1.40**	**1.00**	**1.61*****	**1.05**	**1.12**	**0.87**	**1.36**	**0.98**	**1.56**	**1.04**	**1.46**	**1.09**	**1.25**	**0.94**
Trust - Unofficial Source of COVID-19 Information[1]	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Faith leaders	1.09	1.24	1	1.23	1.21	1.25	1.18	1.28	0.97	1.17	0.65	1.04	1.36	1.24
Close friends and family members	1.56	1.15	1.58	1.15	1.52	1.16	1.58	1.17	1.58	1.12	1.37	1.1	1.63	1.17
Classmates, colleagues or other people you know	1.27	1.06	1.33	1.07	1.19	1.04	1.27	1.08	1.33	1.06	1.2	1.01	1.26	1.03
Contacts on social media	0.79	0.94	0.82	0.96	0.76	0.91	0.81	0.94	0.76	0.83	0.77	0.94	0.75	0.93
Average overall	**1.18**	**0.89**	**1.18**	**0.90**	**1.17**	**0.87**	**1.21[ttt]**	**0.9**	**1.16[t]**	**0.85**	**1.00**	**0.84**	**1.25[tt]**	**0.87**
Consumption - Official Source of COVID-19 Information[2]	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Local government officials (*e.g.*, Governor, Mayor)	1.48	1.18	1.66	1.21	1.23	1.08	1.44	1.17	1.64	1.19	1.52	1.21	1.36	1.08
Federal government (*e.g.*, President, White House COVID Task Force)	1.45	1.18	1.64	1.23	1.19	1.06	1.42	1.15	1.57	1.21	1.51	1.27	1.31	1.09
Print or online news	1.4	1.13	1.52	1.17	1.24	1.05	1.4	1.13	1.42	1.1	1.38	1.2	1.41	1.08
TV or radio	1.36	1.12	1.48	1.16	1.2	1.05	1.38	1.15	1.39	1.07	1.24	1.11	1.26	1.04
Healthcare providers (*e.g.*, Personal Physician/Doctor, Pharmacist, *etc*.)	1.79	1.27	1.88	1.33	1.68	1.17	1.84	1.26	1.75	1.28	1.66	1.29	1.71	1.28
Medical/Health websites (*e.g.*, CDC, WebMD, *etc*.)	1.65	1.21	1.77	1.26	1.48	1.12	1.64	1.20	1.70	1.20	1.65	1.31	1.60	1.18
Average overall	**1.52**	**1.02**	**1.66****	**1.07**	**1.34**	**0.92**	**1.52**	**1.02**	**1.58**	**1.01**	**1.49**	**1.06**	**1.44**	**0.92**
Consumption - Unofficial Source of COVID-19 Information[2]	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Friends, family or neighbors (not including social media)	1.43	1.14	1.38	1.14	1.5	1.14	1.47	1.15	1.34	1.08	1.24	1.11	1.64	1.28
Social media (*e.g.*, Instagram, Facebook, YouTube, TikTok, *etc*.)	1.05	1.08	1.03	1.10	1.08	1.06	1.09	1.07	0.96	1.03	0.86	1.09	1.29	1.16
Average overall	**1.24**	**0.99**	**1.2**	**1.01**	**1.29**	**0.96**	**1.28[ttt]**	**0.98**	**1.15**	**0.94**	**1.05**	**0.98**	**1.47[ttt]**	**1.09**

Table 1. Summary statistics of responses to RADx-UP survey broken down by vaccination status and race/ethnicity.

[1]Question: *How much do you trust each of these sources to provide correct information about COVID-19?* Answers provided on a liker scale: - *Not at all* (0), *A little* (1), *Somewhat* (2) and *A great deal* (3); Reported values represent the mean of the liker scale while the standard deviation is shown inside the parenthesis.

[2]Question: *How often do you use or rely on the following sources to get information about the COVID-19 outbreak?* Answers provided on a liker scale - *Never* (0), *Rarely* (1), *Sometimes* (2), *Often* (3) and *Always* (4). Reported values represent the mean of the liker scale while the standard deviation is shown inside the parenthesis.

*** indicates pairwise statistical significance at $p<0.01$ by two-tailed t-test between the vaccinated vs unvaccinated groups.

[t],[tt],[ttt] indicate pairwise statistical significance at $p<0.1$, $p<0.05$, $p<0.01$ respectively by two-tailed t-test between each shown race/ethnic group vs the white race/ethnic group.

(a)		(b)		(c)	
Trust - Official Source of COVID-19 Information †		**Trust - Unofficial Source of COVID-19 Information ‡**		**Received COVID-19 Vaccine ^**	
Consumption - Official Source	0.641*** (0.031)	**Consumption - Unofficial Source**	0.351*** (0.030)	**Trust - Official Source**[1]	0.532*** (0.060)
				Trust - Unofficial Source[1]	-0.321*** (0.065)
Age	0.004** (0.002)	Age	0.004** (0.002)	Age	0.023*** (0.003)
Race/Ethnicity - NHPI	-0.083 (0.081)	**Race/Ethnicity - NHPI**	0.191** (0.087)	**Race/Ethnicity - NHPI**	-0.013 (0.138)
Race/Ethnicity - Asian	0.070 (0.094)	Race/Ethnicity - Asian	0.134 (0.101)	Race/Ethnicity - Asian	0.223 (0.160)
Race/Ethnicity - Other	-0.269** (0.119)	Race/Ethnicity - Other	0.054 (0.127)	Race/Ethnicity - Other	-0.381** (0.192)
Gender - Male	0.137** (0.054)	Gender - Male	-0.039 (0.058)	Gender - Male	0.030 (0.087)
Gender - Other	0.699 (0.492)	Gender - Other	-0.573 (0.529)	Gender - Other	3.785 (92.816)
Gender - Prefer not to answer	-0.919** (0.400)	Gender - Prefer not to answer	-0.423 (0.429)	Gender - Prefer not to answer	-4.004 (103.465)
Education - High school graduate or GED completed	-0.117 (0.133)	Education - High school graduate or GED completed	-0.070 (0.143)	Education - High school graduate or GED completed	0.206 (0.202)
Education - Some college level/ Technical / Vocational degree	-0.051 (0.138)	Education - Some college level/ Technical / Vocational degree	0.068 (0.148)	Education - Some college level/ Technical / Vocational degree	0.571*** (0.209)
Education - Bachelor's degree	0.073 (0.143)	Education - Bachelor's degree	0.100 (0.154)	Education - Bachelor's degree	0.962*** (0.222)
Education - Other advanced degree (Master's, Doctoral degree)	0.099 (0.142)	Education - Other advanced degree (Master's, Doctoral degree)	0.013 (0.153)	Education - Other advanced degree (Master's, Doctoral degree)	1.132*** (0.222)
Constant	0.340** (0.172)	Constant	0.548*** (0.185)	Constant	-1.654*** (0.274)
Observations	743	Observations	743	Observations	1,128
R^2	0.424	R^2	0.177	Log Likelihood	-622.168
Adjusted R^2	0.415	Adjusted R^2	0.163	Akaike Inf. Crit.	1,272.34
Residual Std. Error	0.688 (df = 730)	Residual Std. Error	0.739 (df = 730)		
F Statistic	44.809*** (df = 12; 730)	F Statistic	13.072*** (df = 12; 730)		

Table 2. Mechanism for vaccine uptake as a function of Trust and Consumption in Official and Unofficial sources. From left to right: (a) OLS Regression of Trust - Official Source as the dependent variable, Consumption - Official Source and demographics as independent variables; (b) Probit Regression of Vaccination Status pas the dependent variable, and Trust - Official Source, Trust Unofficial Source, and demographics as independent variables; (c) OLS Regression of Trust - Unofficial Source as the dependent variable, Consumption - Unofficial Source and demographics as independent variables.

For the regression analyses indicated, significant *p*-values are denoted by * p<0.10; ** p<0.05; ***p<0.01.

[1]The coefficient for Trust - Official Source (0.532) equals to an average 20.68% increase probability of vaccination per unit of trust using the marginal effect of Probit regression. Similarly, the coefficient for Trust - Unofficial Source (-0.321) equals to an average 12.49% decrease probability of vaccination per unit of trust using the marginal effect of Probit regression.