



Original Research

Sociodemographic Differences in Respondent Preferences for Survey Formats: Sampling Bias and Potential Threats to External Validity



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KEYWORDS

Demography;
Disabled persons;
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Abstract Objective: To explore sampling bias as a result of survey format selection by examining associations between characteristics of people aging with long-term physical disability (PAWLTPD) and their preferences for phone or web-based survey format.

Design: A cross-sectional study using a secondary data analysis approach.

Setting: Data were from an ongoing longitudinal cohort study conducted in the community.

Participants: Convenience sampling was used. PAWLTPD who participated in year 2 of the longitudinal cohort study were included. Inclusion criteria were age 45-65 years, English speaking, and self-reported onset of a physical disability at least 5 years prior to study recruitment. Two participants completed the survey using both phone and web formats and were thus excluded; 387 participants (N=387) were included in the analysis.

Interventions: Not applicable.

Main Outcome Measures: Choice of survey format and demographics (age, sex, race and ethnicity, marital status, living arrangement, socioeconomic status) were collected in addition to self-rated physical health.

Results: Participants were on average 58.2 ± 5.6 years old. A total of 33% were male, and 62% were White. Approximately 40% of participants completed phone surveys. The phone survey

List of abbreviations: IRB, Institutional Review Board; OR, odds ratio; PAWLTPD, people aging with long-term physical disability; SES, socioeconomic status.

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group was significantly older ($t=-4.76$, $P<.001$) and had lower education ($U=11133$, $z=-6.65$, $P<.001$) and lower self-rated physical health ($U=15420$, $z=-2.38$, $P=.017$) than the web survey group. Participants who were White ($\chi^2=60.69$; $df=1$; $P<.001$; odds ratio [OR], 0.18) or were in a long-term relationship were less likely to choose phone surveys ($\chi^2=42.20$; $df=1$; $P<.001$; OR, 0.21). Those who earned \$10,008 or less annually ($\chi^2=53.90$; $df=1$; $P<.001$; OR, 5.22) or who lived alone ($\chi^2=36.26$; $df=1$; $P<.001$; OR, 3.64) were more likely to choose phone surveys. Participants with paid work ($\chi^2=16.81$, $df=1$, $P<.001$) tended to select web-based surveys, while those on disability leave ($\chi^2=9.61$, $df=1$, $P<.01$) were more likely to choose phone surveys.

Conclusions: Sociodemographics are associated with survey format choice in PAWLTPD. Findings largely support the existing understanding of digital literacy but also provide insight into the potential occurrence of sampling bias when multiple survey format options are not offered. These findings have implications for investigators who aim to reach a more representative sample of people with disabilities.

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Sampling bias can impair the external validity of a study and limit the generalizability of its findings.¹ When conducting surveys, researchers often choose 1 data collection format (eg, phone or web-based survey) based on cost or other logistical considerations.² Although the decision to use a single survey format can couple with statistical adjustments or other special methods (eg, using random digit dialing to decrease sampling bias),^{2,3} providing a survey in only 1 format can also introduce sampling bias, resulting from accessibility issues such as internet access, telephone and/or mobile phone ownership, service disruption, and participants' physical abilities (eg, visual impairment, hearing difficulties).

Phone and web-based surveys both have the advantages of low cost and wide reach.⁴ Use of these survey formats has become increasingly prevalent with technology development and may have been influenced by the rise of patient-reported outcomes. Phone and web-based surveys gained further prominence as social distancing research tools during the COVID-19 pandemic, particularly among vulnerable populations such as older adults and people with disabilities. Prior studies comparing the use of different survey formats among the general public found that phone surveys had higher response rates and better representation of the study target population than web-based surveys but also demonstrated a social desirability bias,^{4,5} which refers to the tendency of survey respondents to provide socially desirable responses instead of responses that truly reflect their situations. Each survey format has its own strengths, and the choice of survey format is often made in consideration of other practical factors (eg, sensitivity of study topic, technology readiness of a particular target population), but researchers may consider providing multiple format options to eliminate the potential for sampling bias when it is feasible to do so.^{6,7} Previous studies exploring the effect of survey format on research were conducted in the general public. To our knowledge, the potential for sampling bias relating to use of survey formats among aging populations and/or populations with disability and the survey format preferences of these populations are unknown.

This study aimed to explore how survey format selection may introduce sampling bias in studies of people aging with

long-term physical disability (PAWLTPD). Specifically, we examined the associations between characteristics of PAWLTPD and their preferences for a phone or web-based survey. Findings could inform rehabilitation researchers on potential biases in sampling that survey format selection may introduce and assist them in making decisions about survey strategies.

Methods

Study design and setting

This study used existing data collected from year 2 of an ongoing 3-year longitudinal cohort study (2018-2021) investigating the trajectory of function, community participation, and use of long-term supportive services in PAWLTPD. The 3-year longitudinal study was approved by Washington University in St Louis Institutional Review Board (IRB no.: 201710186). PAWLTPD are a group of people who have different ages of onset of their primary disabling conditions and who live with these conditions throughout the rest of their lives. The disabling conditions can begin in early stages of life (eg, cerebral palsy, muscle degeneration), midlife (eg, multiple sclerosis, spinal cord injury), or later stages of life (eg, stroke, chronic obstructive pulmonary disease). PAWLTPD often experience accelerated aging and functional declines earlier in life than the healthy aging population because of their existing physical conditions.

Participants of the cohort study were provided with information related to the longitudinal cohort study using the IRB-approved script. The informed consent was obtained before any data collection. Cohort participants completed an annual survey for 3 years via phone or internet based on their preference. The cohort was recruited through referrals from Area Agencies on Aging and Centers for Independent Living in Missouri as well as from social media. Inclusion criteria were age 45-65 years, English speaking, and self-reported onset of a physical disability at least 5 years before study recruitment. Individuals were excluded if they had a cognitive impairment that could interfere with their ability

to answer survey questions reliably. The phone survey was conducted by trained raters, and the web-based survey was sent to participants via Research Electronic Data Capture 7.^a The survey takes approximately 1 hour to complete by phone and contains a series of questionnaires regarding personal background, services and/or resources used, general health status, disability and comorbid conditions, activity participation and satisfaction, environmental barriers, mental health status, resilience, and social support. The reason for using year 2 survey data for analysis is because year 2 data may more accurately reflect participants' survey format preferences with prior knowledge from year 1 regarding survey content and length. We asked participants about their preference for survey format in year 1 during recruitment, but some participants did choose to switch from phone to web-based survey for the year 2 survey calls.

Participants

Participants in the second year of the cohort study were included in the current study; 2 participants were excluded because of survey completion using both phone and web-based formats (N=387). Among this year 2 cohort of individuals with physical disabilities, the number of years living with one's primary disabling condition ranged from 5-65 years. Approximately 44% of the cohort self-reported having neurologic-related conditions, including cerebral palsy, multiple sclerosis, spinal cord injury, polio, and stroke; 20% reported having musculoskeletal-related conditions, such as total knee replacement, arthritis, or back pain; another 20% reported having other conditions, such as respiratory-, cardiovascular-, immune system-, or genitourinary-related conditions; and the rest of participants self-identified having multiple conditions. The cohort had a diverse constitution of health conditions, so their functional levels also varied. In general, about 29% of participants reported not being able to walk 25 feet on a level surface with or without support. Over half of the participants had difficulty with activities of daily living such as showering, getting in and out of bed, bending down/picking up items from the floor, getting things from up high, or pushing open a heavy door. Approximately 50% of the participants learned about the cohort study in year 1 from internet sources (eg, Facebook, Twitter, website, newsletter), and about 40% of participants learned about the study from noninternet sources (eg, word of mouth, call lists, program officer, flyers).

Measures

Demographic characteristics including age, sex, race and ethnicity, socioeconomic status (SES) (ie, annual personal income, education, employment status), marital status, living arrangement, and physical health were examined. Race was originally a "choose all that apply" variable and was recoded into "White" and "non-White." Participants who indicated White as their only race were recoded as "White." Participants who reported more than 1 race or who reported only 1 non-White race were recoded as "non-White." Marital status was recoded as "married/long-term partnered" and "not in a long-term relationship (ie, single/divorced/separated/widowed)." Education and employment status were recoded into 3 and 4 levels, respectively (table 1). Personal annual income was collected as a dichotomized variable using the Missouri poverty level cutoff (\$10,008). Living arrangement was measured as living at one's primary residence alone or with others. Physical health was collected using a single question asking participants to rate their overall physical health at the time of data collection on a 5-point scale ranging from "excellent" to "poor." It was recoded into 4 levels by combining "excellent" and "very good" into 1 category because of insufficient cell counts. Higher scores indicate worse physical health.

Data analysis

Data were analyzed using SPSS.^b An independent *t* test was conducted to compare age differences between phone and web-based survey groups. Because of the ordinal scale of variables, Mann-Whitney *U* tests were conducted to compare differences in education and self-rated physical health between survey groups. A chi-square test of independence was conducted to explore associations between survey format preference and categorical variables (ie, nominal and ordinal variables). If the omnibus chi-square test was significant and the *df* was >1, post hoc tests were performed by calculating each cell's standardized residual and its squared value (ie, squared standardized residual is equal to χ^2) to determine cells that contributed to the significant associations found in the omnibus chi-square test.⁸ All tests that were conducted were 2-tailed with a 0.05 significance level. The effect sizes of the test results were calculated using Hedges' *g* for *t* test with unbalanced sample sizes, *r* for Mann-Whitney *U* test, and odds ratio (OR) and Cramer's *V* for chi-square test. The post hoc power analysis on the chi-

Table 1 Differences in participant age, education, and self-rated physical health (N=387)

Variable	Phone Survey (n=152, 39.3%) Mean Rank	Web Survey (n=235, 60.7%) Mean Rank	<i>t</i> Test or Mann-Whitney <i>U</i> Test	<i>z</i> Score	<i>P</i> Value
Age (y), mean ± SD	59.8±5.0	57.2±5.7	-4.76*	—	<.001 [†]
Level of education	149.74	222.63	11133	-6.65	<.001 [†]
Self-rated physical health	210.06	183.61	15420	-2.38	.017 [‡]

* *t* test result.

[†] *P*<.001.

[‡] *P*<.05.

square test with the highest number of cells ($df=3$) showed that, given the total sample size ($N=387$), the power to detect a medium effect size ($w=0.3$) with $\alpha=0.05$ is far greater than 0.8 ($\beta=1.00$).

Results

The study included 387 participants. Their mean age was 58.2 ± 5.6 years. A total of 33% were male and 62% were White. Approximately 40% of participants completed phone surveys. The phone survey group was older (59.8 ± 5.0 years) than the web-based survey group (57.2 ± 5.7 years) ($t=-4.76$, $P<.001$), with a medium effect size (Hedges' $g=0.48$). Distributions of education and self-rated physical health for phone and web-based survey groups were not similar, as assessed by visual inspection. Education in the web-based survey group (mean rank=222.63) was statistically significantly higher than in the phone survey group (mean rank= 149.74) ($U=11133$, $z=-6.65$, $P<.001$), with a small effect size ($r=0.11$). Self-rated physical health in the web-based survey group (mean rank=183.61) was statistically significantly better than in the phone survey group (mean rank=210.06) ($U=15420$, $z=-2.38$, $P<.05$), with a small effect size ($r=0.12$) (see [table 1](#)).

Participants who were White ($\chi^2=60.69$; $df=1$; $P<.001$; OR, 0.18) or were in a long-term relationship ($\chi^2=42.20$; $df=1$; $P<.001$; OR, 0.21) were less likely to choose phone surveys; participants who earned \$10,008 or less annually ($\chi^2=53.90$; $df=1$; $P<.001$; OR, 5.22) or who lived alone ($\chi^2=36.26$; $df=1$; $P<.001$; OR, 3.64) were more likely to choose phone surveys ([table 2](#)). Additionally, education level, employment status, and physical health were associated with survey preference, with Cramer's V effect size ranges from 0.35 (considered large when $df=2$), 0.22 (considered medium to large when $df=3$), and 0.15 (considered small to medium when $df=3$), respectively. Post hoc chi-square tests revealed that participants with an education level of high school or below were more likely to choose phone surveys, as shown by the higher observed count than expected count ($\chi^2=44.89$, $df=1$, $P<.001$); conversely, participants with a bachelor's and/or graduate school degree were more likely to choose web-based surveys ($\chi^2=24.01$, $df=1$, $P<.001$). Participants with paid work ($\chi^2=16.81$, $df=1$, $P<.001$) and good physical health ($\chi^2=7.02$, $df=1$, $P<.01$) tended to select web-based surveys, while those on disability leave ($\chi^2=9.61$, $df=1$, $P<.01$) and those with poor physical health ($\chi^2=4.62$, $df=1$, $P<.05$) were more likely to choose phone surveys ([fig 1](#)). With all analyses, there were 5 missing data points, including 4 on the race variable and 1 on the employment status variable.

Discussion

This study examined associations between survey format preference and characteristics of PAWLTPD to explore how sampling bias may be introduced. Findings suggest that SES, marital status, living arrangement, and physical health are associated with survey format preference. A difference in age, education, and self-reported physical health were also found between groups. In other words, participants who

chose different survey formats demonstrated different socio-demographic characteristics. Our findings are similar to those of a few studies that used different platforms (eg, electronic-based vs paper-pencil questionnaires) to collect patient-reported outcomes in patients with cancer and those with knee and/or hip replacement.⁹⁻¹¹ These studies also found that patients who were younger,⁹⁻¹¹ more highly educated,⁹⁻¹¹ married,¹⁰ and had better health-related quality of life⁹ were more likely to use electronic-based questionnaires. However, unlike their findings, sex^{10,11} was not associated with survey format preference in our findings.

In line with existing studies examining internet access among older adults,¹² PAWLTPD who chose the phone survey were older than those who chose the web-based survey. Additionally, our findings showed that White participants were more likely to choose the web-based survey than their non-White counterparts, the majority of whom chose phone surveys. This finding corresponds with the phenomenon of a "digital divide" among different races.¹³

In terms of SES, we found that PAWLTPD with a bachelor's degree or higher and those with an income above the state's poverty threshold were more likely to choose the web-based survey. Conversely, participants with a high-school-level education or below and those with an income at or below the state's poverty threshold were more likely to choose the phone survey. These findings are not surprising because studies of older adults have shown that social disparities closely align with tech disparities; e-literacy and one's ability to afford digital devices could account for these differences.¹² Additionally, employed PAWLTPD tended to choose the web-based survey. This could be because of the length of the survey (~1 hour) in the original study; people with paid employment may have limited personal time to talk on the phone for an hour and appreciate the flexibility provided by a web-based format. Individuals on disability leave were more likely to choose the phone survey. This might be because of worsening health status or loneliness. In contrast with people who are retired, those on disability leave may have newly acquired or worsening conditions that caused them to leave the workforce. Phone surveys provide more human interaction than web-based surveys, which may be appealing to individuals adjusting to these changes (see [supplemental appendix S1](#) for the ancillary test).

Furthermore, we found that PAWLTPD who lived alone were more likely to choose the phone survey than those who lived with others. Higher levels of loneliness among people who live alone may explain this finding; speaking with a phone surveyor could relieve loneliness¹⁴ (see [supplemental appendix S1](#)). Regarding relationship status, PAWLTPD who were married or in a long-term relationship tended to choose the web-based survey; this is in line with a study by Duplaga¹⁵ investigating internet use among people with disabilities, which found that married participants were more likely to use the internet than those who were widowed or never married.¹⁵ Our ancillary test on loneliness and marital status failed to explain the association we found (see [supplemental appendix S1](#)). An alternative explanation should be further explored, including investigating whether health status¹⁶ or patterns of time use vary among people with different marital statuses.

Previous studies have shown that older adults who report better health¹⁶ have greater technology use, including email,

Table 2 Characteristics of participants and relationships with survey format preference (N=387)

Characteristic	Phone survey (n=152, 39.3%) n (%)	Web survey (n=235, 60.7%) n (%)	Omnibus or Post Hoc* χ^2	df	P Value	Odds Ratio or Cramer's V [†]
Sex			1.96	1	.162	1.36
Male	57 (37.5)	72 (30.6)	—	—	—	
Female	95 (62.5)	163 (69.4)	—	—	—	
Race/ethnicity [‡]			60.69	1	<.001 [§]	0.18
White	58 (38.2)	182 (77.4)	—	—	—	
Non-White	92 (60.5)	51 (21.7)	—	—	—	
Marital status			42.20	1	<.001 [§]	0.21
Currently married/long- term partnered	25 (16.4)	115 (48.9)	—	—	—	
Not in a long-term relationship	127 (83.6)	120 (51.1)	—	—	—	
Living arrangement			36.26	1	<.001 [§]	3.64
Living alone	93 (61.2)	71 (30.2)	—	—	—	
Living with others	59 (38.8)	164 (69.8)	—	—	—	
Personal annual income			53.90	1	<.001 [§]	5.22
≤\$10,008	83 (54.6)	44 (18.7)	—	—	—	
≥\$10,009	69 (45.4)	191 (81.3)	—	—	—	
Level of education			48.32	2	<.001 [§]	0.35 [†]
≤High school graduation	74 (48.7)	40 (17.0)	44.89*	1	<.001 [§]	
Expected counts	44.8	69.2	—	—	—	
Some college/tech degree/associate degree	47 (30.9)	90 (38.3)	2.25*	1	.13	
Expected counts	53.8	83.2	—	—	—	
Bachelor's degree/graduate school degree	31 (20.4)	105 (44.7)	24.01*	1	<.001 [§]	
Expected counts	53.4	82.6	—	—	—	
Employment status [‡]			17.95	3	<.001 [§]	0.22 [†]
Paid work full-/part-time	13 (8.6)	59 (25.2)	16.81*	1	<.001 [§]	
Expected counts	28.2	43.8	—	—	—	
Seeking paid work	4 (2.6)	9 (3.8)	0.36*	1	.549	
Expected counts	5.1	7.9	—	—	—	
Retired/other	28 (18.5)	39 (16.7)	0.25*	1	.617	
Expected counts	26.3	40.7	—	—	—	
Disability leave	106 (70.2)	127 (54.3)	9.61*	1	.002	
Expected counts	91.4	141.6	—	—	—	
Self-rated physical health			9.13	3	.028 [¶]	0.15 [†]
Excellent/very good	21 (13.8)	33 (14.0)	0.00*	1	.952	
Expected counts	21.2	32.8	—	—	—	
Good	35 (23.0)	84 (35.7)	7.02*	1	.008	
Expected counts	46.7	72.3	—	—	—	
Fair	61 (40.1)	84 (35.7)	0.76*	1	.384	
Expected counts	57.0	88.1	—	—	—	
Poor	35 (23.0)	34 (14.5)	4.62*	1	.032 [¶]	
Expected counts	27.1	41.9	—	—	—	

NOTE. Table does not show standardized residuals because of limited space and instead shows post hoc χ^2 values (ie, squared standardized residuals) to indicate significant cells. Expected counts are presented to show the direction of significant relationships.

* Post hoc χ^2 value of each cell. Both cells in the same row had the same χ^2 value (because $df=1$). [†]Cramer's V effect size for χ^2 cell numbers larger than 2×2 .

[‡] Race had 4 missing values; employment had 1 missing value.

[§] $P < .001$.

^{||} $P < .01$.

[¶] $P < .05$.

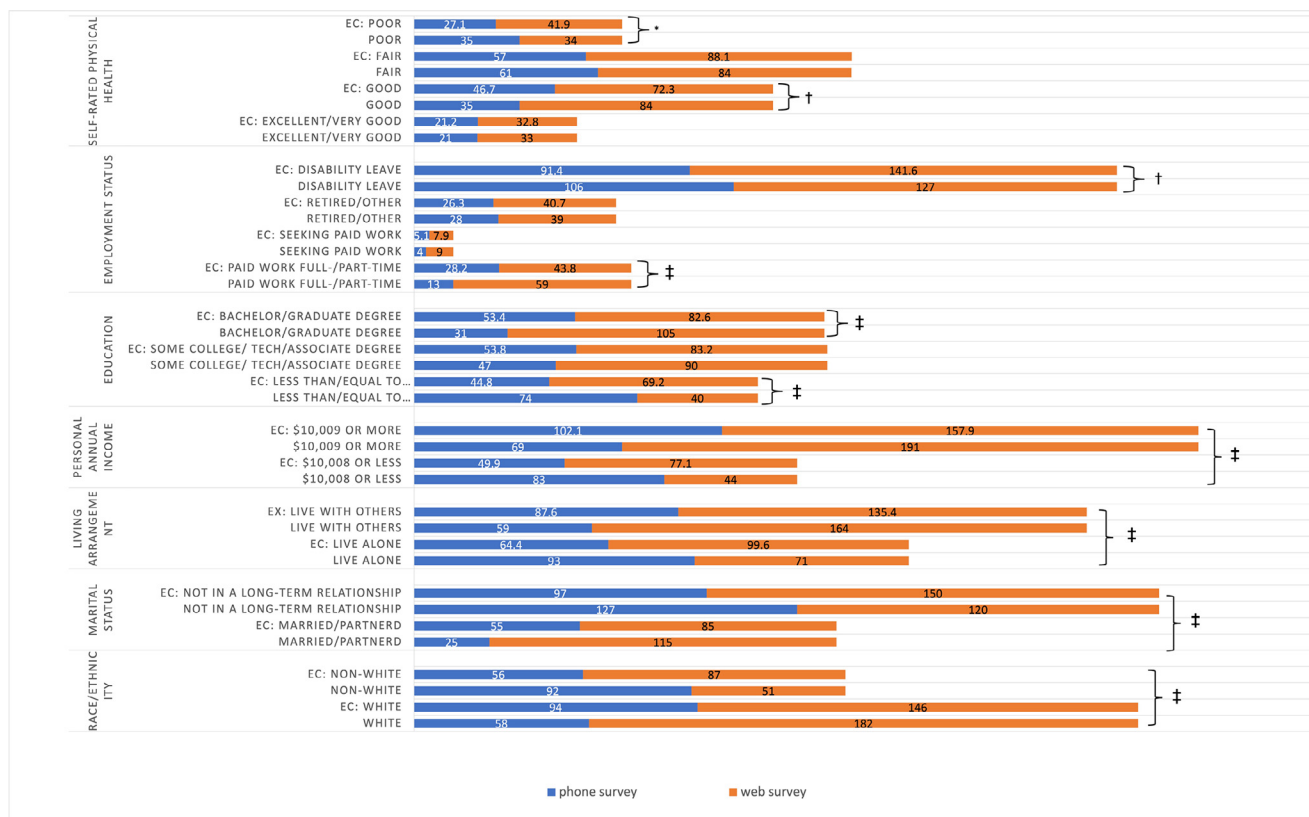


Fig 1 No. of people regarding each participant characteristic and survey format preference. Abbreviation: EC, χ^2 expected counts. * χ^2 significance $P < .05$. † $P < .01$. ‡ $P < .001$.

internet, and text messages. This may explain our finding that PAWLTPD with good physical health were more likely to choose the web-based survey and those with poor physical health were more likely to choose the phone survey.

PAWLTPD are a unique population representing the intersection of aging and physical disability. This study is among the first to provide preliminary findings on how sociodemographics and physical health associate with survey format preferences in PAWLTPD. One strength of this study is that our participants self-selected their survey format. This approach provides a less biased sample of participants because no one was excluded because of difficulty with one format or the other because we have demonstrated that each survey format is likely to appeal to participants who have certain characteristics. Although sampling bias can be addressed using, for example, poststratification weighting during statistical analysis, efforts decreasing sampling bias by using better study design should not be ignored. The study findings could provide insight for planning research recruitment and retention among PAWLTPD with varying characteristics. Providing options for a survey format that participants are more comfortable using could decrease dropout rates in longitudinal studies.¹⁷

Study limitations

A limitation of this study is that it was a cross-sectional study; therefore, causation should not be assumed. This

means that inverse relationships between participant characteristics and survey preferences are also possible. This study also used a convenience sample recruited from community organizations and social media; therefore, the potential for sampling bias cannot be excluded. In addition, as an exploratory study that did not involve any decision making, we did not control the type I error inflation. Future replication studies are warranted and should consider using a multivariate approach such as logistic regression, which has a greater ability to control for type I error and covariates, as well as to clarify multicollinearity issues among predictors.

Conclusions

In summary, individuals' selection of survey format is associated with sociodemographic characteristics. These findings provide evidence to the existing understanding of user characteristics for technologies. Findings demonstrate that sampling bias can be easily introduced in a convenience sample when using 1 survey format: offering only 1 method for survey response may result in lower participation rates of certain sociodemographic groups. When it is feasible (eg, logistics allow, measurement equivalence across different methods of instrument administration have been established), researchers should consider collecting survey data using more than 1 format to improve external validity.

Suppliers

a. REDCap Version 7; Research Electronic Data Capture hosted at Washington University in St Louis. b. SPSS 2017 version; IBM.

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