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## Institute of Medicine Measures of Social and Behavioral Determinants of Health:

### A Feasibility Study

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### Abstract

**Introduction**—Social and behavioral factors are known to affect health but are not routinely assessed in medical practice. To date, no studies have assessed a parsimonious panel of measures of social and behavioral determinants of health (SBDs). This study evaluated the panel of SBD measures recommended by the Institute of Medicine and examined the effect of question order.

**Methods**—Adults, aged 18 years, were recruited using [ResearchMatch.org](https://www.researchmatch.org) for this randomized, parallel design study conducted in 2015 (data analyzed in 2015–2016). Three versions of the SBD measures, sharing the same items but in different orders of presentation (Versions 1–3), were

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developed. Randomized to six groups, participants completed each version at least 1 week apart (Weeks 1–3). Version order was counterbalanced across each administration and randomization was stratified by gender, race, and age. Main outcomes were effect of question order, completion time, and non-response rates.

**Results**—Of 781 participants, 624 (80%) completed the Week 1 questionnaire; median completion time for answering all SBD questions was 5 minutes, 583/624 participants answered all items, and no statistically significant differences associated with question order were observed when comparing responses across all versions. No significant differences in responses within assignment groups over time were found, with the exception of the stress measure for Group 5 ( $p=0.036$ ).

**Conclusion**—Question order did not significantly impact participant responses. Time to complete the questionnaire was brief, and non-response rate was low. Findings support the feasibility of using the Institute of Medicine–recommended questionnaire to capture SBDs.

## Introduction

Social and behavioral factors, such as education, exercise, and smoking, have been shown to affect a number of health conditions<sup>1,2</sup> and have a greater impact on health outcomes than the provision of health care.<sup>3–5</sup> In 2008, WHO called for action to close the gaps in health disparities caused by social determinants.<sup>6</sup> WHO defines these determinants as “conditions in which people are born, grow, live, work and age.”<sup>7</sup> Accordingly, the Centers for Disease Control and Prevention identified social determinants of health as key to their strategic vision for achieving health equity in conditions for which there is a significant disparity in the distribution of the disease burden.<sup>8</sup> The Centers for Medicare and Medicaid Services also note the importance of identifying and responding to social needs in order to improve health outcomes and reduce costs.<sup>9</sup>

Although addressing social and behavioral factors is often considered the realm of public health and government stakeholders, there is an untapped potential for providers to use these determinants to improve clinical practice.<sup>10,11</sup> Recent research has reported on successful implementation of screening tools to identify patients with social needs<sup>12,13</sup> and demonstrated success in addressing those needs by connecting families with community resources.<sup>14</sup> However, there is currently no systematic approach for capturing social data in the clinical setting.

In 2013, the Institute of Medicine (IOM) established a committee to improve clinical management by addressing social and behavioral determinants of health (SBDs). The committee recommended the routine collection of a parsimonious panel of measures that may be obtained by self-report in advance of or during the healthcare encounter and, when used together, provide a psychosocial vital sign.<sup>15–17</sup> The questions were selected for their demonstrated clinical significance and the existence of a proven measure that could be administered in a standard healthcare visit. Although each of the selected SBD measures had been independently validated through previous research, the set of questions has not been evaluated as a combined instrument.

The overall goal of this study was to evaluate the feasibility of using the IOM-recommended panel of SBD questions by examining the effect of question order on participant responses, assessing completion time, and establishing response patterns for unanswered questions. Participant responses were also evaluated to assess relationships between determinants and explore whether the questionnaire operates as expected based on prior research.

## Methods

### Study Design and Participants

This study used a randomized, parallel design to compare three question orders (Table 1): Version 1 included items in the order published by the IOM Committee<sup>15</sup>; Version 2 paralleled the traditional history and physical examination order; and Version 3 was modeled after the 2014 Behavioral Risk Factor Surveillance System questionnaire.<sup>18</sup> The central hypothesis was that there was no difference in responses, completion time, and non-response rates among the three questionnaire versions.

Ethics approval was obtained from Vanderbilt University's IRB. Participants aged 18 years were identified through [ResearchMatch.org](https://www.researchmatch.org), a web-based registry of volunteers from across the U.S.<sup>19</sup> The geographic representation of ResearchMatch participants is largely determined by the recruitment efforts of partnering academic institutions and organizations.<sup>20</sup> For assessing questionnaire completion time, values  $>3$  or  $<3$  SD units from the mean were excluded.

Individuals were equally randomized to six groups (Figure 1) to complete the three questionnaire versions administered at least 1 week apart (referred to as Weeks 1, 2, and 3). Demographic information from volunteers' ResearchMatch profiles was used to stratify the randomization based on gender (male, female), race (white, black, other), and age (18–34, 35–54, 55 years). The computer-generated permuted block randomization sequence, which used block sizes of two and four, was implemented using REDCap, a password-protected application for creating and managing databases and online surveys.<sup>21</sup> Participants were masked to the randomization assignment.

Brief study information was sent to anonymous ResearchMatch volunteers and a link to the REDCap questionnaire was sent to those indicating interest in participating. To minimize response bias,<sup>22</sup> volunteers were not told that the three questionnaires included the same questions in different orders. The recruitment goal was 44 subjects for each of the 18 sampling strata, for a sample size of 792. ResearchMatch response and enrollment rates were closely monitored and invitations were sent iteratively as needed. Participants received a \$15 gift card after completing the Week 3 questionnaire.

### Social and Behavioral Determinants of Health Questionnaire

The IOM-recommended questionnaire includes 25 items addressing the following domains: race and ethnicity, education, financial resource strain, stress, depression, physical activity, tobacco use, alcohol use, social connection or isolation, intimate partner violence, residential address, and Census tract median income (geocoded).<sup>16</sup> Residential address was excluded from this study to limit the amount of identifiable information collected from participants

and because address is routinely collected in healthcare encounters. The item regarding median income was also excluded because it is based on residential address.

Questions were modified to adhere to survey design and clear communication best practices. Changes included using first-person language for race and ethnicity, reversing the order of response options for financial resource strain to range from least to most burdensome to be consistent with other response options, and adding a reference timeframe to the second social connection/isolation question. For the question regarding the highest degree earned, *PhD* was added parenthetically after the *Doctorate* response option to differentiate between “Doctorate” and “Professional” degrees. *I do not know* and *refused* were not included in response options and instead incorporated in probes for questions left blank, which included options such as *I do not know*, *I do not wish to answer*, *I do not understand the question*, or *other*. Selecting an option to explain the reason for refusing to answer was a required field in the questionnaire. Participants who selected *other* were asked to explain why they did not wish to answer; however, they could choose to leave the comment field blank. The full questionnaire, which is based on the IOM recommendations,<sup>15</sup> is available in the Appendix. The questionnaire is also freely available online in the REDCap Shared Library ([www.project-redcap.org/library/index.php](http://www.project-redcap.org/library/index.php)), which may be accessed by academic, non-profit, and government institutions through the REDCap Consortium.

All questionnaires were administered online via REDCap. Participants were invited to take the second and third questionnaires if they completed the preceding questionnaire. A complete questionnaire was defined as providing an answer for all SBD questions. Participants who did not provide an answer but selected an option to explain the reason for refusing to answer were also given subsequent questionnaires.

### Statistical Analysis

The primary endpoints were responses to individual items, completion time, and non-response rates. The sample size estimation was completed using the Bonferroni-adjusted ANOVA method. With a total sample size of 780 (130 per group for six groups), it provides at least 80% power to detect a conservative effect size of 0.5 among six study groups with two-sided Bonferroni-adjusted type I error of 5% (adjusted type I error of 0.0017). The effect size is defined as the ratio between the mean differences between study groups to the SD.

Descriptive statistics are characterized using means with SDs, medians with interquartile ranges (IQRs), or percentages as appropriate. Scores and classifications for depression (Patient Health Questionnaire-2 score), physical activity (Exercise Vital Sign), tobacco use, alcohol use (Alcohol Use Disorders Identification Test, Brief Screen score), social connection or isolation, and intimate partner violence (Humiliation, Afraid, Rape, Kick Questionnaire score) were calculated as described in the Appendix.

Completion time was assessed using Week 1 data only, as they were most generalizable to the conditions under which patients would report information. Missing data were excluded from the analysis. Wilcoxon rank sum test was used to evaluate differences in timing between participants who did not leave any question unanswered and who did leave at least

one question unanswered; Kruskal–Wallis test was used to evaluate differences in completion time among different questionnaire versions.

The chi-square test was employed to evaluate the potential effect of question order. Comparisons were made between groups completing different versions of the Week 1 questionnaire and within the randomization groups, which completed the three versions in varying sequences. Spearman rank correlation was used to measure relationships between domains for Week 1, Survey 1 data.

Two exploratory principal axis factor analyses were conducted to assess underlying constructs (or factors)<sup>23</sup> in the questionnaire items; this information was used to determine whether the SBD questions grouped as predicted based on domain associations reported in prior research.

Both analyses used varimax orthogonal rotations. The first factor analysis was performed using responses to the questions regarding race, ethnicity, highest level of school, financial resource strain, stress, and classification scores for depression, physical activity, tobacco use, alcohol use, social connection or isolation, and intimate partner violence. The second factor analysis differed from the first by using responses to each question for assessing depression, physical activity, tobacco use, alcohol use, social connection or isolation, and intimate partner violence, rather than the classification scores.

Factor loadings were significant at 0.4 or –0.4. All other analyses were significant at the two-sided 5% level. All analyses were conducted in 2015–2016 using R, version 3.3.2 or Stata/IC, version 12.1.

## Results

Invitations to participate in the study were sent to 8,285 ResearchMatch volunteers, of which 1,191 indicated interest in participating. Participants were enrolled until reaching the maximum for each stratum or until all ResearchMatch volunteers within a stratum were contacted. From July 6, 2015 through July 24, 2015, a total of 781 volunteers (Figure 1) were enrolled, randomized, and sent REDCap survey invitations, resulting in a recruitment rate of 9% (781/8,285). The study ended on August 31, 2015. The population was balanced in age, gender, and race (Table 2).

The Week 1 questionnaire response rate was 80% (624/781). Significant group differences in race but not gender or age were seen in participants submitting Week 1 questionnaires versus those that did not (Appendix Table 1). Most participants (93%, 583/624) answered all of the SBD questions, and 7% (41/624) left at least one of the SBD questions unanswered. There were no significant differences in the proportion of respondents answering all the SBD questions by version or over time.

There were no significant differences in Week 1 questionnaire completion time across the three versions. The median completion time for those answering all SBD items was 5 minutes (IQR=4–7 minutes,  $n=574$ ). Although there were no significant differences in completion time by gender, there were significant differences by age and race; however, the

median completion time was 5 minutes for all groups. Participants who received prompts asking the reason for items left blank took significantly longer (median, 7 [IQR=6–8.5] minutes;  $n=39$ ;  $p<0.001$ ).

There were 11 SBD questions for which at least one participant left the item blank. The question regarding the number of standard drinks containing alcohol a participant had on a typical day was left blank by 34 respondents, of which 33 indicated that they left the question blank because *zero* was not an option. Three participants did not answer the question regarding race and selected that they did not wish to answer. Two subjects did not answer the first depression screening question and chose the option *I do not know*. Eight additional items were left unanswered by one participant each. There were no patterns detected in questions left blank by version.

There were no significant differences in responses to the first questionnaire (Week 1) across the three versions (Table 3). When evaluating responses by randomization group, no significant differences were observed over time across the three versions, except in the reporting of stress in Group 5 ( $p=0.04$ ). More individuals in Group 5 reported having *quite a bit* or *very much* stress on the first questionnaire they received (36 of 100 participants), which was Version 3, than on the two subsequent questionnaires (23 of 100 participants, each). Group 6 also completed Version 3 first, but there were no significant differences in responses over time across the three versions.

The first factor analysis revealed two factors. The first factor included the questions regarding financial resource strain, stress, and depression. The second factor included the question regarding the highest level of school completed (Appendix Table 2). The second factor analysis showed six factors (Appendix Table 3):

1. stress and depression;
2. three of the alcohol use questions;
3. both education questions;
4. both physical activity questions;
5. three of the intimate partner violence questions; and
6. four of the social connection or isolation questions.

Significant correlations were observed between questionnaire responses for multiple SBD domains (Appendix Table 4). The highest correlations were seen between stress and depression ( $r=0.48$ ,  $p<0.0001$ ), financial resource strain and stress ( $r=0.46$ ,  $p<0.0001$ ), and financial resource strain and depression ( $r=0.37$ ,  $p<0.0001$ ).

When feasible, participant responses were descriptively compared against nationally representative data. Given variations in availability and question or item response phrasing, direct comparisons were only possible for highest degree earned, depression, tobacco use, and social connection/isolation (Appendix Table 5). This study population had a higher proportion of individuals with a graduate degree (31%, 191/619 vs 11%, 25,670/242,248), more individuals with positive screening for depression (18%, 114/621 vs 10%, 476/4,949),

a higher percentage of individuals categorized as “most isolated” (27%, 165/621 vs 13%, 2,469/19,618), and fewer current smokers (10%, 64/623 vs 17%, 6,378/36,697).

## Discussion

This study is the first step in demonstrating the feasibility of using the IOM-recommended panel of measures for assessing SBDs. The results regarding brevity and willingness to respond are encouraging. The finding that the questionnaire took approximately 5 minutes to complete and that few participants left items blank suggests the feasibility of incorporating it into the healthcare encounter workflow. Question order did not significantly impact participant responses, which supports the use of any of the three tested versions.

With one exception, the analysis of questionnaire responses revealed no significant differences based on version. In both Groups 5 and 6, a higher percentage of participants reported having *quite a bit* or *very much* stress when completing the first questionnaire (Version 3); however, the differences across versions were only significant for Group 5. These results further support the use of any of the three questionnaire versions. The finding that question order did not have a significant effect was not surprising given that in all three versions of the survey, sensitive questions, such as those regarding intimate partner violence, were reserved for the end of the questionnaire.

The only question left blank by more than a few participants was the second question regarding alcohol use, which asked about the number of drinks consumed on a typical day. Participants received this question if they responded with any answer other than *never* to the preceding question that asked how often they have a drink containing alcohol. Participants who left the second question blank were almost exclusively those who had reported in the prior question that they drink monthly or less; they wanted to choose a response of zero drinks, which was not a response option. To address this concern, the wording of this item should be used as it appears in the original source,<sup>24</sup> which specifies *...on a typical day when you are drinking*, rather than the wording in the IOM report.<sup>15</sup> The addition of the qualifier *... when you are drinking* eliminates the need for a *zero* response option.

The significant correlations observed between SBD domains are consistent with previous literature, suggesting that the questionnaire operates as expected. For example, studies indicate that depression is associated with stress and financial resource strain.<sup>25–29</sup> Consistent with these findings, the highest significant positive correlations were among depression, stress, and financial resource strain (Appendix Table 4).

Results from the factor analyses support the construct validity of the questionnaire. Both factor analyses (Appendix Tables 2–3) showed that the stress and depression questions loaded onto the same factor, suggesting a common relationship between the two domains, and the analysis using summary scores additionally showed that financial resource strain loaded with these questions. These findings are consistent with the literature showing an association among financial strain, depression, and stress.<sup>26–28</sup>

In the factor analysis using individual items, the questions regarding marital status and rape did not load together with other questions in their domain. In addition to stress and



depression loading onto a common factor, the analysis revealed five additional constructs (i.e., alcohol, education, physical activity, intimate partner violence, and social connection/isolation) clearly indicating a consistency with the SBD they were intended to assess. The finding that the questions mapped onto distinct factors consistent with their domain was not surprising, given that the items were drawn from previously validated instruments designed to measure distinct SBDs.

### Limitations

The study had the following limitations. Participants with graduate or professional school education, a positive screening for depression, and categorized as most socially isolated were over-represented in the sample. Current smokers were under-represented and 55% of respondents (343/623, Table 3) reported no financial resource strain. The resulting selection bias is likely a direct consequence of using a survey approach with a self-selected online population.<sup>30</sup> An important additional limitation is that questionnaire performance was not assessed in the context of a healthcare encounter. Response rates and patterns may differ under the stress of, and limited time available during, clinical encounters and when the questionnaire is publicly administered, particularly for sensitive questions.

### Conclusions

This study makes an important contribution by establishing the feasibility of implementing the IOM-recommended SBD questions. The questionnaire was harmonized using best practices and the study showed that question order did not affect participant responses, the non-response rate was low, and the completion time was brief. The factor analyses and exploratory evaluation of associations between domains provide preliminary evidence that the patterns of questionnaire responses are consistent with the existing literature. These findings provide reassurance that clinical practices that wish to implement the IOM committee recommendations can use the questionnaire as tested to systematically capture information about patients' social and behavioral health needs. Remaining challenges include determining when to administer the questionnaire, how to deliver the results in clinical care, and how to best intervene. Future research into each of these areas will further reduce barriers to incorporating the questionnaire into clinical practice.

### Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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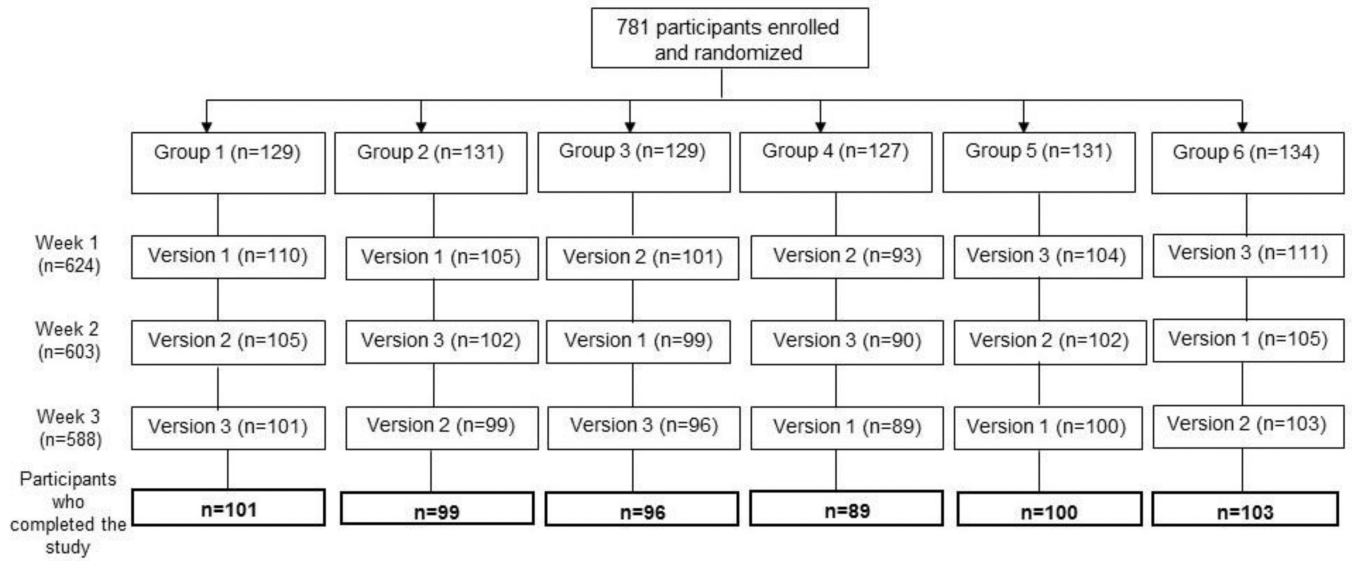
collaboratively by NG, TK, SK, LH, and SP, under the direction of NG, and all authors critically reviewed and edited the manuscript.

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**Figure 1.**  
Participant flowchart.

**Table 1**

## Question Domain Order by Survey Version

Version 1	Version 2	Version 3
Race	Tobacco use	Stress
Ethnicity	Alcohol use	Depression
Education	Financial resource strain	Physical activity
Financial resource strain	Physical activity	Ethnicity
Stress	Stress	Race
Depression	Depression	Education
Physical activity	Social connection or isolation	Tobacco use
Tobacco use	Intimate partner violence	Alcohol use
Alcohol use	Race	Financial resource strain
Social connection or isolation	Ethnicity	Social connection or isolation
Intimate partner violence	Education	Intimate partner violence

*Note:* The full set of questions and response options for each domain are given in the Appendix.

**Table 2**

## Characteristics of Enrolled ResearchMatch Volunteers

Characteristics	All enrolled (n=781)	Group 1 (n=129)	Group 2 (n=131)	Group 3 (n=129)	Group 4 (n=127)	Group 5 (n=131)	Group 6 (n=134)
Gender							
Male	385 (49%)	64 (50%)	65 (50%)	64 (50%)	62 (49%)	64 (49%)	66 (49%)
Female	396 (51%)	65 (50%)	66 (50%)	65 (50%)	65 (51%)	67 (51%)	68 (51%)
Race							
White	264 (34%)	43 (33%)	46 (35%)	43 (33%)	43 (34%)	43 (33%)	46 (34%)
Black	254 (33%)	43 (33%)	43 (33%)	43 (33%)	40 (32%)	43 (33%)	42 (31%)
Other	263 (34%)	43 (33%)	42 (32%)	43 (33%)	44 (35%)	45 (34%)	46 (34%)
Age range (years)							
18–34	264 (34%)	43 (33%)	44 (34%)	43 (33%)	43 (34%)	45 (34%)	46 (34%)
35–54	264 (34%)	44 (34%)	45 (34%)	43 (33%)	44 (35%)	44 (34%)	44 (33%)
55 and older	253 (32%)	42 (33%)	42 (32%)	43 (33%)	40 (32%)	42 (32%)	44 (33%)
Age (years)	42 (30–57)	44 (30–58)	40 (31–57)	44 (29–58)	42 (32–57)	42 (30–57)	42 (30–57)

Notes: Data are n (%) or median (IQR). Percentages may not equal 100% due to rounding. Data used is based on information from each participant's ResearchMatch profile. The study population was balanced in age, gender, and race.

Table 3

## Week 1 Responses by Version

Domain	Version 1 (n=215)	Version 2 (n=194)	Version 3 (n=215)	p-value <sup>a</sup>
Race				0.65
White	91/214 (43%)	81/193 (42%)	92/214 (43%)	
Black	56/214 (26%)	57/193 (30%)	63/214 (29%)	
Other	34/214 (16%)	31/193 (16%)	39/214 (18%)	
Two or more races	33/214 (15%)	24/193 (12%)	20/214 (9%)	
Ethnicity				0.59
No, not Hispanic, Latino, or Spanish origin	196/215 (91%)	171/194 (88%)	194/215 (90%)	
Yes, Hispanic, Latino, or Spanish origin	19/215 (9%)	23/194 (12%)	21/215 (10%)	
Highest level of school				0.95
1–16 years (elementary school/high school/college)	132/215 (61%)	121/194 (62%)	131/215 (61%)	
17+ years (graduate/professional school)	83/215 (39%)	73/194 (38%)	84/215 (39%)	
Highest degree earned				0.22
Less than high school, high school diploma, or GED	48/213 (23%)	31/191 (16%)	36/215 (17%)	
Vocational certificate or Associate degree	27/213 (13%)	37/191 (19%)	27/215 (13%)	
Bachelor's degree	69/213 (32%)	64/191 (34%)	89/215 (41%)	
Master's degree	50/213 (23%)	44/191 (23%)	43/215 (20%)	
Doctorate or professional degree	19/213 (9%)	15/191 (8%)	20/215 (9%)	
Financial resource strain				0.33
Not hard at all	112/215 (52%)	115/194 (59%)	116/214 (54%)	
Somewhat hard or Very hard	103/215 (48%)	79/194 (41%)	98/214 (46%)	
Stress				0.45
Not at all	35/215 (16%)	22/194 (11%)	26/215 (12%)	
A little bit	73/215 (34%)	70/194 (36%)	65/215 (30%)	
Somewhat	56/215 (26%)	47/194 (24%)	57/215 (27%)	
Quite a bit or very much	51/215 (24%)	55/194 (28%)	67/215 (31%)	
Depression (PHQ-2 score)				0.18
Negative screen (<3)	179/213 (84%)	161/193 (83%)	167/215 (78%)	
Positive screen (≥ 3)	34/213 (16%)	32/193 (17%)	48/215 (22%)	
Physical activity (EVS classification)				0.48
Inactive	36/214 (17%)	27/194 (14%)	44/215 (20%)	
Insufficiently active	100/214 (47%)	89/194 (46%)	91/215 (42%)	
Sufficiently active	78/214 (36%)	78/194 (40%)	80/215 (37%)	
Tobacco use				0.88
Never smoker	138/215 (64%)	125/194 (64%)	147/214 (69%)	
Former smoker	54/215 (25%)	48/194 (25%)	47/214 (22%)	
Current every day or current some day smoker	23/215 (11%)	21/194 (11%)	20/214 (9%)	
Alcohol use (AUDIT-C score)				0.62
Negative screen (women <3, men <4)	142/206 (69%)	128/180 (71%)	135/203 (67%)	
Positive screen (women ≥ 3, men ≥ 4)	64/206 (31%)	52/180 (29%)	68/203 (33%)	

Domain	Version 1 (n=215)	Version 2 (n=194)	Version 3 (n=215)	<i>p</i> -value <sup>a</sup>
Social connection or isolation				0.71
Not isolated	33/214 (15%)	33/193 (17%)	31/214 (14%)	
Somewhat isolated	60/214 (28%)	59/193 (31%)	57/214 (27%)	
Very isolated	69/214 (32%)	48/193 (25%)	66/214 (31%)	
Most isolated	52/214 (24%)	53/193 (27%)	60/214 (28%)	
Intimate partner violence (HARK score)				0.20
Negative screen (<1)	171/215 (80%)	166/194 (86%)	171/215 (80%)	
Positive screen (≥ 1)	44/215 (20%)	28/194 (14%)	44/215 (20%)	

*Notes:* Data are n/N (%). Percentages may not equal 100% due to rounding. There were no significant differences in responses to the Week 1 questionnaire across the three versions.

<sup>a</sup>Pearson  $\chi^2$  test.

AUDIT-C, Alcohol Use Disorders Identification Test, Brief Screen; EVS, Exercise Vital Sign; HARK, the HARK (Humiliation, Afraid, Rape, Kick) Questionnaire; PHQ-2, Patient Health Questionnaire-2 score

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