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# Mass Messaging and Health Risk Reduction

## Evidence from COVID-19 Text Messages in Tajikistan

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## Abstract

Can mass public health messages change behavior during a crisis? This paper assesses the impact of a COVID-19 focused text-messaging campaign launched in May 2020 with the Ministry of Health and Social Protection of Tajikistan to encourage compliance with risk reduction measures. The initiative sent a series of informational messages to about 5.5 million mobile phone subscribers and reached at least one member of more than 90 percent of the country's households. An individual fixed effects estimator is used to measure changes in reported behavior after a respondent lists text messages as a primary source of information about COVID-19, or alternatively when reporting an official text message in the past week. Listing text messaging as a primary source of information increased the number of reported behaviors by 0.15 units ($p = 0.000$) and receiving an official text message in the past week increased the number by 0.47 units ($p = 0.000$). These effects were driven by more positive responses for wearing masks, reducing visits with friends and relatives, reducing travel, practicing safer greetings (such as fewer handshakes), and safety-related changes at work. The results suggest that text messaging–based public health messaging was a cost-effective means of increasing awareness in a large and geographically dispersed audience during the COVID-19 pandemic and that the program led to an increase in self-reported risk reducing behaviors.


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# Mass Messaging and Health Risk Reduction

## Evidence from COVID-19 Text Messages in Tajikistan

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JEL: D8, D83, I1, I15, I18, O1

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# I – Introduction

In the early months of the COVID-19 pandemic, health authorities around the world scrambled to inform the public about how to reduce the risk of infection. Modes of message-sending varied substantially depending on local contexts, and multi-mode campaigns were common. Television announcements and dedicated news segments were widely used, complemented where feasible by smartphone alerts, radio broadcasts, social media services, newspaper reports, and even personal appeals from health care workers.

With more than 5 billion unique mobile phone subscribers in the world,[2] COVID-19 information campaigns also turned to short message service (SMS) text messages in many countries. A standardized message bank for these initiatives was quickly developed and prompted by the World Health Organization and other international organizations.[3] The text messaging approach had several key strengths, especially in reaching out to geographically disperse populations, and in low and middle-income countries where advanced smartphone penetration remained limited. In such situations (i.e. large numbers of both smartphone and basic mobile phone users) text messaging was often the "lowest common denominator" to reach the maximum audience. These constraints were highly relevant to the setting of this study. Data from the Listening to Tajikistan survey shows that before the outbreak, mobile phone coverage was quite high, with about 95 percent of the population reporting access to at least one mobile phone in their immediate household (and 108 connections per 100 people in 2019 according the GSMA industry association). However, the number of *mobile internet connections,* which are required for most smartphone functions and social media applications, was much lower, standing at just 55 connections per 100 people in 2019 according to the same source.

Designs for SMS-based COVID-19 messaging campaigns have been widely documented since the start of the pandemic. Details of campaigns in the United Kingdom,[4] Taiwan, China (Huang, 2020), Saudi Arabia (Hassounah, Hafsa, and Mohammed Alhefzi, 2020), Brazil (Rico et. al., 2020), Kenya (Austrian et. al., 2020) and Denmark are only a small sample.[5] However, evidence for the efficacy of these programs is more fragmented, and in the few cases where systems have been evaluated, results have been mixed thus far. For instance, in a large randomized control trial in Denmark, Falco and Zaccagni (2020) found that text message reminders to social distance did not appear to have had any impact on individual actions in that setting. Austrian et. al (2020) however, found that SMS messages on COVID-19 from Kenya's government were among the most trusted sources of information on the pandemic and risk reduction behaviors among the population there.

Text messages have also been shown to be highly effective in other public health contexts. For instance, a systematic meta-analysis by Mekonnen et al. (2019) found substantial improvements with

[2] Live tracking application available at this link
[3] The official message bank is available at this link
[4] Link to government website
[5] Link to newspaper article

respect to encouraging vaccination. Another meta-analysis from Mayer and Fontelo (2017) found significant positive effects of text message reminders for HIV-related treatment compliance. Yet another meta-analysis found significant impacts from reminders on treatment for coronary heart disease (Zhao, 2019). Other studies have found significant impacts on feeding programs (e.g. Zhou et al.) and case management practices (e.g. Zurovac, 2011).

In the face of both past success using similar methods, suggestive evidence of positive uptake in cross-sectional survey measures, and initial null effects from an RCT evaluation of a similar project design, uncertainty remains as to whether and under what circumstances SMS-based messages can be effective at encouraging risk reducing behavior during a public health crisis like COVID-19.

In the following, I describe a mass SMS text-messaging campaign conducted together with the health authorities in Tajikistan and implemented alongside a monthly individual panel survey that measured self-reported risk reduction behavior. The results demonstrate that receiving and relying on text messages for information on COVID-19 led to a significant increase in self-reported risk reduction behaviors. Listing SMS as a primary source of information increased the number of reported behaviors by .15 units ($p = 0.000$) and receiving an official text message in the past week increased the number by .47 units ($p = 0.000$). These effects were driven by more positive responses for wearing masks, reducing visits with friends and relatives, reducing travel, practicing safer greetings (fewer handshakes, etc.) and safety-related changes to work. The results suggest that SMS-based public health messaging was a cost-effective means of increasing awareness in a large and geographically dispersed audience during the COVID-19 pandemic, and that the program led to an increase in self-reported risk reducing behaviors.

The remainder of the paper is structured as follows. Section II provides details on the country context, discussion of the messaging campaign, and a description of the data used in the study. Section III briefly describes the pooled ordinary least squares (OLS), and fixed effects estimators used to measure differences in reporting behaviors between message-receiving and non-receiving respondents. Section IV includes of the results, and section V a discussion of the study's implications.

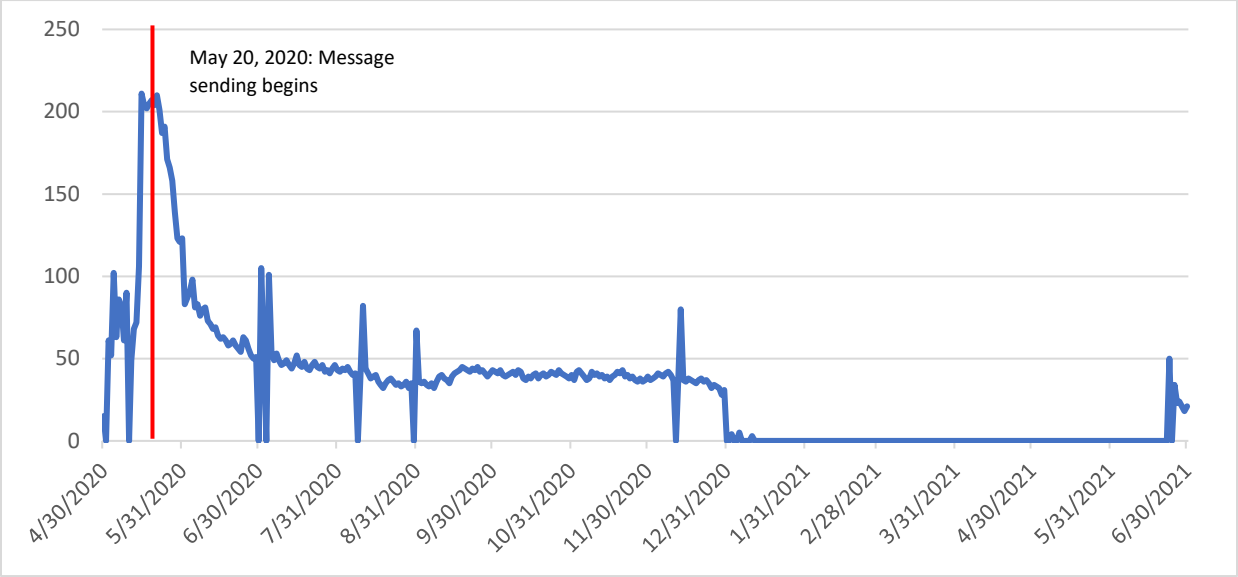
## II – Context, Messaging, and Data

About 93 percent of Tajikistan's territory is occupied by mountains and only about 6 percent of land is arable. About 70 percent of the population lives in rural areas and most reside in the valleys in the western half of the country. There are numerous small communities scattered in difficult-to-reach mountainous regions. Due in part to this challenging terrain, authorities often struggle to communicate with and provide public services to people living in remote areas where long travel times are common. National surveys, including the main data source for this study, find that large majorities of respondents see improving basic public services (such as health and education) as high priority issues,

and satisfaction with services is especially low in rural areas. A recent World Bank impact evaluation also found that these factors lead to shortfalls in demand and under-utilization of public health services.

When cases of COVID-19 were first confirmed in Tajikistan in April 2020, there were few reliable tools to quickly convey urgent health information to the public. Survey data collected during that time show that television emerged as the primary source of official announcements, while relatively small numbers of people also got information from newspapers, the internet, and social media. A somewhat larger number of people received their information in-person from health care providers and other officials; however, these interactions were still limited, especially in areas with unreliable transportation and other infrastructure. The challenges of communication and service delivery were further complicated in an environment where in-person contact was unsafe due to the risk of spreading infection.

**Figure 1: Daily number of confirmed cases**




*Source: Our World in Data*

To address the difficulty of quickly disseminating key public health messages, the World Bank launched the initial design phase of the Mobile Engage project in March 2020, with financial support from a Trust Fund financed by the Republic of Korea.[6] The project focused on providing crucial public health information about reducing the risks posed by COVID-19 via SMS to the general population.[7] The project received official endorsement from the Ministry of Health and Social Protection of Tajikistan in April 2020. Messages were first sent in May 2020 and managed in close

[6] https://www.worldbank.org/en/programs/korea-trust-fund

[7] In parallel, the Mobile Engage project financed development of a targeted messaging system to send messages to specific phone numbers in preparation for vaccination rollout for the purposes of notifying priority groups on local vaccine availability. This system was completed in early 2021.

collaboration with the Agency for Communication under the Government of Tajikistan. The messages were sent to all mobile phones and were not "targeted" to particular users or groups at elevated risk.

The campaign used existing SMS-systems maintained by the country's three largest mobile operators[8] From May to December 2020, the project sent COVID-19 related public health messages to approximately 5.5 million mobile phone subscribers in both Russian and Tajik languages (Table 1). The content of the messages was developed in consultation with the MoHSP based on recommendations from the World Health Organization's COVID-19 SMS database. The messages were directly attributed to the Ministry in each message and focused on preventing the spread of COVID-19. The SMS messages focused on specific behaviors from the list including handwashing, avoiding handshakes and hugs, more frequent cleaning and disinfecting items, not touching one's face and mouth, wearing masks, quarantining sick individuals, and social distancing. For a full list of the messages sent, see Appendix A.

**Table 1: SMS-messaging through Mobile Engage in Tajikistan, May to December 2021**

| Mobile operator | Period | Approx. subscribers | Messages (Tajik and Russian) | Total SMS sent |
|---|---|---|---|---|
| TCell (round 1) | May 2020 | 2,477,274 | 8 (T/R) | 39,636,384 |
| TCell (round 2) | Jul-Sept 2020 | 2,477,274 | 7 (T/R) | 34,681,836 |
| Babilon M | Nov-Dec 2020 | 1,056,586 | 6 (T+R) | 6,339,517 |
| Megafon | May 2020 | ~2,000,000 | 1 (T+R) | 2,000,000 |
| | Total | 5,533,860 | | 82,657,737 |

Alongside the Mobile Engage project, the Government of Tajikistan also endorsed an expansion of the existing Listening to Tajikistan (L2T) survey, another World Bank initiative, to collect individual and household data on the social and economic impacts of the COVID-19 pandemic. L2T is a continuous monthly household panel survey conducted over the phone with a nationally representative sample of about 1,200 households. The L2T survey was first launched in 2015, and because interviews are conducted over the phone, continued operation without interruption during the COVID-19 pandemic when in-person interviews were not possible. This study uses the national panel survey data to assess the impact of the Mobile Engage project on reported risk reducing behaviors.

The L2T survey was organized around two primary components. The first was a comprehensive in-person baseline survey, conducted in 2015, and supplemented with a second similar comprehensive in-person survey completed in 2017. The baseline sample design used a stratified two-stage clustered approach, with a target of national as well as regional representativeness for household consumption and expenditure. The sample frame was the national census of Tajikistan conducted in 2010. In the first stage, 150 clusters (census tracts) were randomly selected from the census, with a probability of selection proportional to size. In the second stage, 3,000 households were randomly selected from

[8] TCell, Megafon, and Babilon M

within the selected clusters (using a simple random sample protocol) to participate in the baseline survey.

The second component of the L2T survey was a monthly household panel conducted over the phone, with a randomly selected subset of households that participated in the baseline. Selection was stratified such that a fixed number of households were selected to participate in each cluster included in the baseline survey. This approach ensured that the geographic spread of participants remained as dispersed as in the baseline survey and minimized the intra-cluster correlation of respondent characteristics to the best extent possible. The target sample size over the relevant period in 2020 was 1,200 households per month. The sample weights for households were adjusted to reflect the subsample design conducted using the baseline interviews and updated monthly to account for (modest) rates of attrition.[9]

The panel component of the L2T survey largely focuses on dimensions of well-being that have the potential to fluctuate over time, including (i) migration and remittances, (ii) jobs and income, (iii) deprivations and subjective well-being, and (iv) utilities and services. During the pandemic, the survey was updated with a new module about the well-being of the population, including indicators on the public's understanding of preventive and risk-minimization measures related to COVID-19. Several questions from the COVD-19 focused module are of particular interest in this study. These include the questions fully described in Appendix C.

Table 2 provides a summary of interviews completed and risk reducing behaviors reported. A total of 10,963 interviews including the COVID-19 specific module were completed between April 2020 and January 2021. On average, households reported a total of 5.9 of the 9 responses available. As official endorsement of the module was received late in April 2020, only 219 interviews including those questions could be completed in April. Thereafter, the sample reached was generally slightly below the monthly target of 1,200 interviews per month. Nearly all respondents reported changing at least some routines to reduce the risk of COVID-19 throughout the crisis. About 98 percent report increasing handwashing, and a similarly high share (95 percent) report mask use. It is important to note that for these behaviors, very high rates of reporting reduce the scope for potential measured effects, as they are both already near the maximum potential value.

It is important to note that with these and other indicators, the underlying survey questions measure if the household did these *at all*, but not whether they are intensely or consistently applied. Also, responses to such survey questions could be affected by social desirability bias, potentially resulting in a higher prevalence of reported behaviors than are in fact practiced. This arises when respondents in a survey feel compelled to provide "the right" or expected answer to a question. However, it is unlikely that these concerns affect the main results of the assessment described in later sections. The results rely on comparing changes in reported behavior among people who received SMS messages at the time of their interview (or who otherwise rely on those messages), and those who did not. As

[9] For more detail, please see the technical note on the L2T survey, available here.

comparisons are conducted for the same individuals over time, messages would have to affect person-specific desirability bias in some way to affect the results. This is an implausible explanation for the within-respondent patterns I find.

**Table 2: Sample Distribution and Risk Reducing Behaviors**

| | Total Int. | Rur | Urb | Total Beh. | Hand Wash | Greet | Trav. | Visit | Work | Mask | Soc. Dist | Stock Food | Quar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apr | 219 | 166 | 53 | 4.36 | 92% | 37% | 61% | 67% | 38% | 87% | 23% | 17% | 13% |
| May | 1,278 | 950 | 328 | 6.40 | 99% | 81% | 85% | 81% | 68% | 98% | 61% | 34% | 34% |
| Jun | 1,198 | 899 | 299 | 6.62 | 98% | 94% | 93% | 85% | 59% | 98% | 64% | 34% | 34% |
| Jul | 1,205 | 909 | 296 | 6.74 | 99% | 98% | 97% | 96% | 50% | 97% | 68% | 35% | 35% |
| Aug | 1,194 | 904 | 290 | 6.44 | 97% | 92% | 92% | 88% | 50% | 95% | 64% | 34% | 33% |
| Sep | 1,143 | 856 | 287 | 5.62 | 98% | 71% | 70% | 68% | 43% | 89% | 57% | 33% | 33% |
| Oct | 1,174 | 874 | 300 | 6.06 | 98% | 69% | 69% | 68% | 65% | 98% | 67% | 36% | 36% |
| Nov | 1,195 | 896 | 299 | 5.57 | 97% | 67% | 67% | 65% | 41% | 94% | 58% | 35% | 34% |
| Dec | 1,191 | 901 | 290 | 5.55 | 98% | 70% | 69% | 69% | 38% | 97% | 39% | 37% | 37% |
| Jan | 1,166 | 884 | 282 | 5.04 | 96% | 62% | 61% | 62% | 32% | 95% | 32% | 32% | 32% |
| Total | 10963 | 8239 | 2724 | 5.91 | 98% | 76% | 77% | 75% | 48% | 95% | 55% | 34% | 34% |

Between 75 and 77 percent of respondents reported reducing risky greetings (such as kissing, handshakes, and hugging), reduced traveling, and less visiting with friends and others outside of their immediate family. Other behaviors fluctuated more over the course of the pandemic, and were on average less common, including social distancing (55 percent on average), changes in typical work habits (48 percent) increasing the stock of reserve food (34 percent) and quarantine measures (34 percent).

As presented in table 3, television was by far the most common mode of receiving any information about COVID-19, with about 96 percent of respondents listing it as a primary source. In-person sources were next most common, with information from health workers more common than other individuals. The third most common source was SMS, averaging about 21 percent over the full period, and a peak of 29 percent during the height of project messaging. The only official SMS messages being sent during this time were from the Mobile Engage project, suggesting that many of these responses referred to these. This interpretation is bolstered by the fact that in a companion study in neighboring Uzbekistan, where no mass text-messaging campaign was conducted, only 8.9 percent of respondents listed SMS as a primary source over the same period. About 12 percent of respondents listed radio, 5 percent social media, and only 2 percent newspapers (either electronic or physical) as primary sources of information.

**Table 3: Respondents Primary Sources of Information**

| | Rely on Source for Any COVID-19 Information | | | | | | |
|---|---|---|---|---|---|---|---|
| | *tv* | *newspaper* | *radio* | *soc. med* | *sms* | *pers. health* | *pers other* |
| Apr-20 | 89% | 11% | 15% | 10% | 16% | 12% | 10% |
| May-20 | 92% | 3% | 8% | 9% | 25% | 34% | 19% |
| Jun-20 | 96% | 1% | 7% | 6% | 29% | 40% | 27% |
| Jul-20 | 96% | 1% | 16% | 5% | 20% | 43% | 25% |
| Aug-20 | 95% | 2% | 11% | 5% | 20% | 39% | 23% |
| Sep-20 | 94% | 2% | 17% | 4% | 15% | 36% | 27% |
| Oct-20 | 97% | 1% | 14% | 4% | 16% | 38% | 28% |
| Nov-20 | 96% | 4% | 16% | 5% | 20% | 39% | 32% |
| Dec-20 | 97% | 1% | 8% | 2% | 26% | 43% | 30% |
| Jan-21 | 98% | 1% | 9% | 3% | 18% | 40% | 25% |
| Total | 96% | 2% | 12% | 5% | 21% | 39% | 26% |

As presented in Table 4, reports of the respondent personally having heard official announcements and guidance provided by government in the week preceding the interview were less common than relying on information sources overall. A maximum of 40 percent of respondents reported receiving official guidance on TV in the previous week, falling to about 33 percent overall. One of the key variables of interest in this study, reporting having received an official SMS message in the week preceding the interview, peaked at about 5 percent of respondents in May 2020. This is a rather strict definition of "treatment," as it requires the respondent personally received the message in the specific window preceding the interview, and a separate survey question established that at least one member received messages in more than 90 percent of households. The timing of the L2T interviews did not by design correspond to the message-sending schedule of the Mobile Engage initiative. This was due to the decision of the project team to send messages as soon as technically feasible, given the urgency of the situation, rather than wait for ideal measurement conditions. Nonetheless, the survey identified 152 cases in which respondents reported these messages in the week immediately preceding their interview.

**Table 4: Having Seen Official Information on COVID-19 in the Past Week (by Source)**

| | Received Official Information in Past 7 Days | | | | | | |
|---|---|---|---|---|---|---|---|
| | *tv* | *newspaper* | *radio* | *soc. med* | *sms* | *pers. health* | *pers other* |
| Apr-20 | 40% | 6% | 7% | 3% | 4% | 16% | 5% |
| May-20 | 40% | 0% | 2% | 1% | 5% | 19% | 6% |
| Jun-20 | 26% | 0% | 1% | 0% | 4% | 14% | 3% |
| Jul-20 | 27% | 1% | 1% | 1% | 1% | 9% | 2% |
| Aug-20 | 25% | 0% | 1% | 0% | 1% | 6% | 2% |
| Sep-20 | 34% | 0% | 1% | 0% | 1% | 6% | 5% |
| Oct-20 | 33% | 0% | 1% | 0% | 0% | 6% | 5% |
| Nov-20 | 34% | 0% | 1% | 0% | 0% | 6% | 5% |
| Dec-20 | 35% | 0% | 1% | 0% | 0% | 6% | 3% |
| Jan-21 | 38% | 0% | 0% | 0% | 0% | 7% | 1% |
| | 33.2% | 0.3% | 1.0% | 0.3% | 1.4% | 8.9% | 3.4% |

# III – Methods

In the following section, the differences in reporting risk reduction behaviors begins with simple pooled ordinary least squares (OLS) estimates of the association between reporting SMS messages and the outcomes of interest. These descriptive regressions demonstrate average differences in reporting between those who report receiving (or relying on) messages, and those who do not. Controls for urban location, log income per capita, and month of interview are cumulatively added.

Then, the direct impact of messages on reported behavior is identified by means of an individual fixed effect estimator. By removing individual and household characteristics that are either almost entirely time-invariant (such as location and gender) or nearly time invariant (such as household type, living space, and connections to services) this approach more clearly establishes the link between SMS messages and relevant time-varying behavioral indicators. The approach accounts for both "observed" characteristics that are enumerated in the survey, as well as "unobserved" sources of heterogeneity. This also accounts for time-invariant dimensions issues relating to locations, such as unobserved amenities. The goal is to estimate a regression equation of the form:

$$BEHit = \alpha i + \beta SMSit + \beta Iit + \varepsilon it \qquad \text{Eq. 1}$$

Where BEHit is a measure of household *i*'s reported risk mitigation behavior at time *t*, *ai* is the time-invariant household-level component, SMSit is a dummy variable equal to one when a respondent reports SMS messages, and zero otherwise, for household *i* at time *t*, and *I* is time-varying per capita income (included as a control variable where appropriate). Deriving estimates of the terms $\beta$ for the SMSit dummy variable is the objective of the procedure. Positive values suggest a positive relationship between having received a message in the preceding week (or relying on messages as a primary source of information on COVID-19) and reporting risk mitigation behaviors.

In the results reported below, the robust option in Stata is used throughout to control for potential heteroskedasticity. This precludes accounting for the survey's clustered sampling design using the SVY package in Stata (which does not allow "robust" option for standard errors). However, I perform a sensitivity check of the results by re-estimating identical models using the SVY prefix (and without the robust option). The results are nearly identical, and the choice does not materially affect any result reported below.

Finally, to establish the appropriateness of the proposed fixed effects approach, I also conduct a Hausman test for each specification, where the null hypothesis is that the preferred model is random effects vs. the proposed fixed effects alternative. The results clarify that the fixed effects approach is preferred in all relevant cases.

# IV – Results

The key results of the study are described in tables 5 and 6. Table 5 reports a series of regression specifications in which the dependent variable measures the number of risk reduction behaviors reported (ranging from 0-9) and the independent variable of interest is a measure of the respondent listing SMS as a primary source of information. A total of 10,963 observations are available for this

procedure, covering 2,153 unique individual respondents. Columns 1-3 provide simple pooled OLS regressions, adding more control variables moving from left to right. The coefficient reported in column 1 suggests those relying on SMS on average report about 1.5 more reported behaviors, significantly higher reporting than those who do not list SMS messages as a primary source. Adding more control variables to this basic estimation (columns 2 and 3) does not materially affect the coefficient. The sign and significance of the control variables suggest that people living in urban areas report more risk reducing behaviors on average, as do higher income people (columns 2 and 3).

But as these simple relationships reported in the first three columns of table 5 are merely descriptive, they could be driven by many potential causes. A more rigorous approach to assess the effect of messages is to focus on changes in reporting risk reducing behaviors within the same individuals over time, as described in equation 1. Column 4 of table 5 reports the results for this specification including the same (time-varying) independent variable of reliance on SMS messages as a primary source of COVID-19 information. The value of about .15 for the coefficient of interest suggests that reporting SMS messages significantly increases the total number of reported behaviors by .15 units (with p=0.000). The case that messages themselves are the driver of reported changes in behavior is more compelling using such a fixed effects approach because the fixed effects estimator fully accounts for any influential omitted time-invariant (or nearly invariant) characteristics such as location, education, gender, etc. As an additional control, including log (real) per capita income (column 5) does not materially affect the coefficient of interest.

**Table 5: Relying on SMS vs. Total Number of Behaviors Reported**

| | y = number of behaviors reported (out of 9) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 1.530*** | 1.428*** | 1.375*** | 0.154*** | 0.154*** |
| | (0.057) | (0.056) | (0.055) | (0.038) | (0.038) |
| Urban | | 0.203*** | 0.194*** | | |
| | | (0.068) | (0.068) | | |
| Ln(income pc) | | 0.289*** | 0.290*** | | 0.008 |
| | | (0.012) | (0.012) | | (0.008) |
| Constant | 5.588*** | 4.674*** | 3.328*** | 5.900*** | 5.876*** |
| | (0.034) | (0.051) | (0.175) | (0.008) | (0.025) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.052 | 0.108 | 0.153 | 0.002 | 0.002 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

A second measure of exposure to messages is the respondent reporting having received an official message in the week before the interview. Results for specifications using this measure are reported in table 6. This measure is more stringent than the variable of interest in table 5, as it limits the concept of "treatment" to only the period immediately preceding the interview. Although survey results suggest that more than 90 percent of households received messages at some point in the period

covered, only a small number of these messages by chance occurred in the week preceding an interview in the L2T survey.

Columns 1-3 in table 6 provide simple pooled regressions, as before, adding more control variables moving from left to right. The coefficient for receiving an official SMS reported in column 1 suggests those who received messages in the week preceding the interview report about .3 more reported behaviors on average, significantly higher reporting than those who do not report a message. Adding more control variables to this basic estimation (columns 2 and 3) does materially affect the coefficient of interest. The sign and significance of the control variables suggest that people living in urban areas report more risk reducing behaviors on average, as do higher income people (columns 2 and 3). However, the inclusion of controls for month of interview absorbs the differences in reporting in the basic descriptive OLS regression (column 3). This suggests that in a descriptive sense, reporting differences cannot be distinguished from a time trend.

Focusing again on changes in a fixed effects framework in columns 4 and 5 of table 6 shows that messages in the past week lead to about .47 additional behaviors. Controlling for income (column 5) does not materially affect the coefficient of interest. Thus, for both definitions of treatment, the results suggest that messages significantly increased reporting risk reducing behaviors.

**Table 6: Receiving Official SMS in Previous Week vs. Behaviors Reported**

| | y = number of behaviors reported (out of 9) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Gov. SMS past week | 0.306*** | 0.458*** | 0.091 | 0.467*** | 0.473*** |
| | (0.113) | (0.131) | (0.130) | (0.119) | (0.120) |
| Urban | | 0.228*** | 0.219*** | | |
| | | (0.070) | (0.070) | | |
| Ln(income pc) | | 0.306*** | 0.307*** | | 0.009 |
| | | (0.013) | (0.012) | | (0.008) |
| Constant | 5.904*** | 4.907*** | 3.495*** | 5.926*** | 5.898*** |
| | (0.030) | (0.050) | (0.177) | (0.002) | (0.023) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.000 | 0.063 | 0.112 | 0.002 | 0.002 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Breaking out individual behaviors in many cases highlights the primary contributions to the overall effect, though can be challenging due to the smaller sample sizes available for changes at the individual behavior level. These estimates are reported in tables 7-15. In each table, columns 1-5 report results for relying on SMS as a primary source of information on COVID-19, and columns 6-10 report results related to having received a message in the preceding week. Although the broad patters are similar, the way messaging is measured (either relying on the source or receiving a message in the preceding week) leads to some differences in which behaviors are reported more commonly. Additionally, in some cases, only modest impacts are identified due to low variation in responses. Both mask wearing

and handwashing (reported in table 7 and table 12) were very common, and near their theoretical maximum value. This limits the scope for a fixed effect estimator to identify meaningful changes.

For the measure of treatment being those who relied on messages as a primary source of information, this led to more reports of changing greetings (table 8, column 5), significantly less travel (table 9, column 5), significantly fewer visits (table 10 column 5), changing work patterns (table 11, column 5), and more mask wearing (table 12, column 5).

For receiving no SMS message in the previous interview, treatment leads to increased reporting of changing greetings (table 8, column 10), significantly less travel (table 9, column 10), changing work patterns (table 11, column 10), and social distancing (table 13, column 10). In contrast to other measures, those receiving messages in the past week reported less buying food reserves (table 14, column 10), and less quarantine and isolation measures (table 15, column 10).

The final two coefficients pose challenges of interpretation. Buying food reserves was not a risk reduction behavior recommended by messages, and it is thus not clear if it should be considered a potential outcome of "treatment." Quarantine measures were also only recommended in cases of suspected illness which may have led to differences in the need to undertake quarantine measures. Quarantine measures are positively and significantly associated with reporting an ill family member. Removing both variables leads to qualitatively similar headline results with respect to measuring total behaviors reported (i.e. behavior out of 7 rather than out of 9). In both cases, the increase in the number reported behaviors rises when excluding these measures, suggesting that the main results conservatively report the estimated effect.

**Table 7: Receiving SMS vs. Increased Handwashing**

| | More Handwashing = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.003 | 0.003 | 0.002 | 0.006 | 0.006 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Urban | | 0.006 | 0.005 | | |
| | | (0.003) | (0.003) | | |
| Ln(income pc) | | 0.000 | -0.000 | | -0.000 |
| | | (0.001) | (0.001) | | (0.001) |
| Constant | 0.976*** | 0.975*** | 0.915*** | 0.976*** | 0.977*** |
| | (0.002) | (0.003) | (0.019) | (0.001) | (0.003) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.000 | 0.000 | 0.006 | 0.000 | 0.000 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | More Handwashing = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | -0.008 | -0.008 | -0.011 | -0.014 | -0.014 |
| | (0.013) | (0.013) | (0.013) | (0.016) | (0.016) |
| Urban | | 0.006 | 0.005 | | |
| | | (0.003) | (0.003) | | |
| Ln(income pc) | | 0.000 | -0.000 | | -0.000 |
| | | (0.001) | (0.001) | | (0.001) |
| Constant | 0.977*** | 0.975*** | 0.916*** | 0.977*** | 0.978*** |
| | (0.002) | (0.003) | (0.019) | (0.000) | (0.003) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.000 | 0.000 | 0.006 | 0.000 | 0.000 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 8: Receiving SMS vs. Reporting Safer Greetings**

| | Safer Greetings = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.265*** | 0.256*** | 0.242*** | 0.043*** | 0.043*** |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) |
| Urban | | -0.034*** | -0.034*** | | |
| | | (0.010) | (0.010) | | |
| Ln(income pc) | | 0.030*** | 0.030*** | | 0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.707*** | 0.625*** | 0.258*** | 0.760*** | 0.747*** |
| | (0.005) | (0.009) | (0.034) | (0.001) | (0.006) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.064 | 0.090 | 0.186 | 0.003 | 0.003 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | Safer Greetings = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | 0.199*** | 0.217*** | 0.158*** | 0.068*** | 0.071*** |
| | (0.016) | (0.017) | (0.019) | (0.020) | (0.020) |
| Urban | | -0.029*** | -0.030*** | | |
| | | (0.011) | (0.010) | | |
| Ln(income pc) | | 0.033*** | 0.033*** | | 0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.759*** | 0.665*** | 0.281*** | 0.768*** | 0.755*** |
| | (0.005) | (0.009) | (0.034) | (0.000) | (0.005) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.003 | 0.034 | 0.136 | 0.001 | 0.001 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 9: Receiving SMS vs. Reporting Less Travel**

| | Less Travel = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.259*** | 0.250*** | 0.237*** | 0.032*** | 0.032*** |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) |
| Urban | | -0.033*** | -0.034*** | | |
| | | (0.010) | (0.010) | | |
| Ln(income pc) | | 0.030*** | 0.030*** | | 0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.711*** | 0.632*** | 0.505*** | 0.768*** | 0.755*** |
| | (0.005) | (0.009) | (0.035) | (0.001) | (0.005) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.062 | 0.087 | 0.174 | 0.001 | 0.002 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | Less Travel = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | 0.204*** | 0.222*** | 0.143*** | 0.068*** | 0.070*** |
| | (0.014) | (0.016) | (0.018) | (0.020) | (0.020) |
| Urban | | -0.029*** | -0.030*** | | |
| | | (0.011) | (0.010) | | |
| Ln(income pc) | | 0.033*** | 0.033*** | | 0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.763*** | 0.670*** | 0.527*** | 0.773*** | 0.761*** |
| | (0.005) | (0.009) | (0.035) | (0.000) | (0.005) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.003 | 0.033 | 0.125 | 0.001 | 0.001 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 10: : Receiving SMS vs. Reporting Fewer Visits**

| | Fewer Visits = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.274*** | 0.263*** | 0.255*** | 0.023*** | 0.023*** |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) |
| Urban | | -0.040*** | -0.040*** | | |
| | | (0.011) | (0.010) | | |
| Ln(income pc) | | 0.034*** | 0.035*** | | 0.003* |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.688*** | 0.596*** | 0.551*** | 0.745*** | 0.736*** |
| | (0.006) | (0.009) | (0.034) | (0.001) | (0.005) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.065 | 0.097 | 0.158 | 0.001 | 0.001 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | Fewer Visits = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | 0.193*** | 0.214*** | 0.154*** | 0.032 | 0.034 |
| | (0.019) | (0.020) | (0.022) | (0.021) | (0.021) |
| Urban | | -0.035*** | -0.036*** | | |
| | | (0.011) | (0.011) | | |
| Ln(income pc) | | 0.038*** | 0.038*** | | 0.003* |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.743*** | 0.637*** | 0.575*** | 0.750*** | 0.740*** |
| | (0.005) | (0.009) | (0.034) | (0.000) | (0.005) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.003 | 0.041 | 0.104 | 0.000 | 0.001 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 11: Receiving SMS vs. Reporting Changing Work Patterns**

| | Change Work Patterns = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.200*** | 0.185*** | 0.178*** | 0.039*** | 0.039*** |
| | (0.013) | (0.012) | (0.012) | (0.010) | (0.010) |
| Urban | | 0.063*** | 0.061*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.042*** | 0.043*** | | -0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.437*** | 0.297*** | 0.225*** | 0.479*** | 0.492*** |
| | (0.006) | (0.009) | (0.034) | (0.002) | (0.006) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.027 | 0.063 | 0.120 | 0.002 | 0.002 |
| Unique individuals | | | | 2,153 | 2,153 |

| | Change Work Patterns = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | 0.090** | 0.111** | 0.011 | 0.206*** | 0.203*** |
| | (0.042) | (0.044) | (0.043) | (0.041) | (0.041) |
| Urban | | 0.067*** | 0.064*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.044*** | 0.045*** | | -0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.478*** | 0.326*** | 0.247*** | 0.484*** | 0.496*** |
| | (0.005) | (0.009) | (0.034) | (0.001) | (0.006) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.000 | 0.041 | 0.100 | 0.005 | 0.006 |
| Unique individuals | | | | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 12: Receiving SMS vs. Reporting Wearing Masks**

| | Wear Masks = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.013*** | 0.012** | 0.007 | 0.026*** | 0.026*** |
| | (0.005) | (0.005) | (0.005) | (0.006) | (0.006) |
| Urban | | 0.017*** | 0.017*** | | |
| | | (0.005) | (0.005) | | |
| Ln(income pc) | | 0.002* | 0.002** | | -0.001 |
| | | (0.001) | (0.001) | | (0.001) |
| Constant | 0.952*** | 0.942*** | 0.862*** | 0.948*** | 0.951*** |
| | (0.002) | (0.004) | (0.023) | (0.001) | (0.004) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.001 | 0.002 | 0.021 | 0.002 | 0.002 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | Wear Masks = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | 0.001 | 0.002 | -0.007 | 0.028 | 0.028 |
| | (0.015) | (0.015) | (0.015) | (0.021) | (0.021) |
| Urban | | 0.018*** | 0.017*** | | |
| | | (0.005) | (0.005) | | |
| Ln(income pc) | | 0.002* | 0.002** | | -0.001 |
| | | (0.001) | (0.001) | | (0.001) |
| Constant | 0.954*** | 0.944*** | 0.863*** | 0.953*** | 0.956*** |
| | (0.002) | (0.004) | (0.023) | (0.000) | (0.003) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.000 | 0.002 | 0.021 | 0.000 | 0.000 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 13: Receiving SMS vs. Reporting Social Distancing**

| | Social distancing = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.263*** | 0.248*** | 0.248*** | -0.012 | -0.012 |
| | (0.012) | (0.012) | (0.011) | (0.010) | (0.010) |
| Urban | | 0.009 | 0.006 | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.045*** | 0.044*** | | -0.001 |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.490*** | 0.354*** | 0.073** | 0.558*** | 0.561*** |
| | (0.006) | (0.009) | (0.031) | (0.002) | (0.006) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.046 | 0.085 | 0.156 | 0.000 | 0.000 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | Social distancing = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | 0.211*** | 0.236*** | 0.186*** | 0.155*** | 0.155*** |
| | (0.038) | (0.039) | (0.036) | (0.035) | (0.035) |
| Urban | | 0.013 | 0.010 | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.048*** | 0.047*** | | -0.001 |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.542*** | 0.392*** | 0.096*** | 0.553*** | 0.555*** |
| | (0.005) | (0.009) | (0.032) | (0.001) | (0.005) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.002 | 0.048 | 0.118 | 0.004 | 0.004 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 14: Receiving SMS vs. Reporting Buying Food Reserves**

| | Buy food reserve = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.125*** | 0.104*** | 0.102*** | -0.003 | -0.003 |
| | (0.013) | (0.012) | (0.012) | (0.004) | (0.004) |
| Urban | | 0.107*** | 0.107*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.054*** | 0.053*** | | 0.002** |
| | | (0.002) | (0.002) | | (0.001) |
| Constant | 0.315*** | 0.128*** | -0.010 | 0.335*** | 0.330*** |
| | (0.006) | (0.008) | (0.027) | (0.001) | (0.002) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.011 | 0.082 | 0.084 | 0.000 | 0.001 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | Buy food reserve = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | -0.290*** | -0.265*** | -0.270*** | -0.035** | -0.034** |
| | (0.020) | (0.023) | (0.024) | (0.014) | (0.014) |
| Urban | | 0.109*** | 0.109*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.054*** | 0.054*** | | 0.001** |
| | | (0.002) | (0.002) | | (0.001) |
| Constant | 0.345*** | 0.150*** | 0.015 | 0.335*** | 0.331*** |
| | (0.005) | (0.008) | (0.027) | (0.000) | (0.002) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.005 | 0.078 | 0.081 | 0.001 | 0.002 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

**Table 15: Receiving SMS vs. Reporting Self-Isolation Quarantine**

| | Self-Isolation/Quarantine Measures = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SMS primary source | 0.128*** | 0.107*** | 0.105*** | 0.000 | 0.000 |
| | (0.013) | (0.012) | (0.012) | (0.004) | (0.004) |
| Urban | | 0.107*** | 0.106*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.053*** | 0.053*** | | 0.002** |
| | | (0.002) | (0.002) | | (0.001) |
| Constant | 0.312*** | 0.125*** | -0.051** | 0.332*** | 0.327*** |
| | (0.006) | (0.008) | (0.025) | (0.001) | (0.002) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.012 | 0.082 | 0.086 | 0.000 | 0.001 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

| | Self-Isolation/Quarantine Measures = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| Gov. SMS past week | -0.296*** | -0.271*** | -0.275*** | -0.041*** | -0.040*** |
| | (0.018) | (0.021) | (0.022) | (0.015) | (0.016) |
| Urban | | 0.109*** | 0.109*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.054*** | 0.054*** | | 0.002** |
| | | (0.002) | (0.002) | | (0.001) |
| Constant | 0.343*** | 0.148*** | -0.026 | 0.333*** | 0.328*** |
| | (0.005) | (0.008) | (0.025) | (0.000) | (0.002) |
| Month control | No | No | Yes | Ind. FE | Ind. FE |
| Observations | 10,963 | 10,963 | 10,963 | 10,963 | 10,963 |
| R-squared | 0.005 | 0.078 | 0.082 | 0.002 | 0.003 |
| Unique individuals | 2,153 | 2,153 | 2,153 | 2,153 | 2,153 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

# V – Discussion

This study sheds new light on the effectiveness of messaging campaigns in promoting risk reducing behaviors during a crisis, such as the COVID-19 pandemic. The results show that both key measures of interest (either (i) relying on SMS as a source of information on COVID-19, or (ii) receiving an official message in the week preceding the interview) significantly increase reported risk reduction behaviors in a nationally representative sample of adults in Tajikistan. This suggests that SMS-based campaigns can be an effective mode of mass communication to encourage compliance with public health guidance during such crisis situations.

In addition, a strong feature of the mass messaging undertaken in this case was its relatively affordability. It was a cost-effective means to quickly reach a large and geographically dispersed audience. The cost per message for the Mobile Engage initiative varied depending upon the telecom provider, but most messages were sent at a unit cost of .006 somoni (about .0005 USD). This is with respect to a unique audience and compares favorably to the cost of many modes available in mass media campaigns. In addition, though not the case in Tajikistan, many countries legally require mobile phone providers to send emergency messages on behalf of the authorities, further reducing the direct cost of such campaigns in times of need.

The findings described in this study are likely relevant for similar campaigns going forward in Tajikistan, and potentially other contexts as well. For instance, as COVID-19 vaccination campaigns are in the early stages in many countries, additional improvement in outcomes may be effectively encouraged using similar messaging approaches. Both Mobile Engage and the Listening to Tajikistan survey have been endorsed to evaluate the effectiveness of this application in the context of the vaccination campaign underway in 2021 in Tajikistan.

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# Appendix A

Annex 1. Contents of SMS-messages on COVID-19 prevention.

1st Round:

1. Министерство здравоохранения: Часто мойте руки с мылом! Вазорати тандурустӣ ва ҳифзи иҷтимоии аҳолии ҶТ: Дастонатонро зуд-зуд бо собун шӯед!
2. Министерство здравоохранения: Избегайте рукопожатий и объятий! Аз саломкунии даст ба даст ва оғӯш худдорӣ намоед!
3. Министерство здравоохранения: Не прикасайтесь руками к своему лицу (рту, носу или глазам)! Бо дастҳоятон ба рӯи худ (даҳон, бинӣ ё чашм) даст нарасонед!
4. Министерство здравохронения: Обрабатывайте антисептиками часто используемые предметы быта! Ашёи дар рӯзгор тез-тез истифодашавандаро бо антисептикҳо тоза кунед!
5. Министерство здравохронения: При выходе из дома, наденьте маску! Ҳангоми аз хона баромадан, ниқобро пушед!
6. Министерство здравохронения: Соблюдайте дистанцию "2 метра" в общественных местах! Дар ҷойҳои ҷамъиятӣ масофаи "2 метрро" риоя кунед!
7. Министерство здравохронения: Номер горячей линии МЗСЗН РТ по коронавирусу 511 и 311! Рақами доимоамалкунандаи ВТ ва ҲИА ҶТ оид ба коронавирус 511 ва 311!
8. Министерство здравохронения: При повышенной температуре, кашле или одышке, изолируйте себя от других членов семьи и позвоните семейному врачу! Ҳангоми баландшудани ҳарорати бадан, сулфа ё нафастангӣ, худро аз дигар аъзоёни оила ҷудо кунед ва ба табиби оилавӣ занг занед!

2nd Round:

1. Новый коронавирус до сих пор распространяется, сохраняйте осторожность! Коронавируси нав ҳоло ҳам паҳн шуда истодааст, боэҳтиёт бошед!
2. Вирус в основном распространяется через мелкие капли из носа или рта, когда инфицированный человек кашляет, чихает или говорит. Вирус асосан тавассути қатраҳои хурд аз бинӣ ё даҳон ҳангоми сулфазанӣ, нафаскашӣ ё сухан гуфтани шахси сироятшуда паҳн мегардад.
3. Носите лицевые маски при выходе на улицу, чтобы сократить риск заражения других людей. Ҳангоми ба кӯча баромадан даҳону биниятонро бо ниқоб пӯшонед, то хатарро барои худ ва дигарон кам намоед.
4. В общественных местах сохраняйте социальную дистанцию с людьми не менее 2 метров. Дар ҷойҳои ҷамъиятӣ бо одамон фосилаи на камтар аз 2 метрро нигоҳ доред.
5. При кашле или чихании прикрывайте рот и нос локтем или салфеткой. Ҳангоми сулфидан ё нафаскашӣ даҳон ва бинии худро бо оринҷ ё дастмол пӯшонед.
6. Коронавирусной инфекцией COVID-19 может заразиться любой человек. Будьте внимательны к другим. Ҳар як шахс метавонад аз коронавирусии COVID-19 сирояд ёбад. Нисбати шахсони сироятёфта эҳтиёткор бошед.

# Appendix B – Household fixed effects

## Greetings

| | Change behavior of greetings = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.265*** | 0.256*** | 0.242*** | 0.041*** | 0.042*** |
| | (0.007) | (0.007) | (0.007) | (0.006) | (0.006) |
| urban | | -0.034*** | -0.035*** | | |
| | | (0.010) | (0.010) | | |
| Ln(income pc) | | 0.030*** | 0.030*** | | 0.005*** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.707*** | 0.626*** | 0.258*** | 0.761*** | 0.746*** |
| | (0.005) | (0.009) | (0.034) | (0.001) | (0.005) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.064 | 0.090 | 0.186 | 0.002 | 0.003 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

## Handwashing

| | Change behavior of handwashing = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.003 | 0.003 | 0.002 | 0.006 | 0.006 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| urban | | 0.005 | 0.005 | | |
| | | (0.003) | (0.003) | | |
| Ln(income pc) | | 0.000 | -0.000 | | -0.000 |
| | | (0.001) | (0.001) | | (0.001) |
| Constant | 0.976*** | 0.975*** | 0.915*** | 0.976*** | 0.976*** |
| | (0.002) | (0.003) | (0.019) | (0.001) | (0.003) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.000 | 0.000 | 0.006 | 0.000 | 0.000 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

## Mask-wearing

| | Change behavior of mask-wearing = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.013*** | 0.012** | 0.007 | 0.027*** | 0.027*** |
| | (0.005) | (0.005) | (0.005) | (0.006) | (0.006) |
| urban | | 0.017*** | 0.017*** | | |
| | | (0.005) | (0.005) | | |
| Ln(income pc) | | 0.002* | 0.002** | | -0.001 |
| | | (0.001) | (0.001) | | (0.001) |
| Constant | 0.952*** | 0.942*** | 0.862*** | 0.948*** | 0.951*** |
| | (0.002) | (0.004) | (0.023) | (0.001) | (0.003) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.001 | 0.002 | 0.021 | 0.002 | 0.003 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

## Buy reserve food

| | Buy reserve food = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.124*** | 0.104*** | 0.101*** | -0.002 | -0.002 |
| | (0.013) | (0.012) | (0.012) | (0.004) | (0.004) |
| urban | | 0.107*** | 0.107*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.053*** | 0.053*** | | 0.001** |
| | | (0.002) | (0.002) | | (0.001) |
| Constant | 0.315*** | 0.128*** | -0.009 | 0.335*** | 0.330*** |
| | (0.006) | (0.008) | (0.027) | (0.001) | (0.002) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.011 | 0.082 | 0.084 | 0.000 | 0.001 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

## Self-isolation/Quarantine

| | Self-Isolation/Quarantine Measures = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.127*** | 0.107*** | 0.104*** | 0.001 | 0.001 |
| | (0.013) | (0.012) | (0.012) | (0.004) | (0.004) |
| urban | | 0.107*** | 0.106*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.053*** | 0.053*** | | 0.002** |
| | | (0.002) | (0.002) | | (0.001) |
| Constant | 0.312*** | 0.126*** | -0.051** | 0.332*** | 0.327*** |
| | (0.006) | (0.008) | (0.025) | (0.001) | (0.002) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.012 | 0.082 | 0.085 | 0.000 | 0.001 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

## Social Distancing

| | Change behavior of Social Distancing = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.263*** | 0.247*** | 0.247*** | -0.008 | -0.008 |
| | (0.012) | (0.012) | (0.011) | (0.010) | (0.010) |
| urban | | 0.009 | 0.006 | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.045*** | 0.044*** | | -0.000 |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.490*** | 0.355*** | 0.074** | 0.557*** | 0.558*** |
| | (0.006) | (0.009) | (0.031) | (0.002) | (0.005) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.046 | 0.085 | 0.156 | 0.000 | 0.000 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

## Reduce Travel

| | Reduce Travel = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.259*** | 0.250*** | 0.236*** | 0.031*** | 0.031*** |
| | (0.007) | (0.007) | (0.007) | (0.005) | (0.005) |
| urban | | -0.034*** | -0.034*** | | |
| | | (0.010) | (0.010) | | |
| Ln(income pc) | | 0.030*** | 0.030*** | | 0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.712*** | 0.632*** | 0.505*** | 0.768*** | 0.755*** |
| | (0.005) | (0.009) | (0.035) | (0.001) | (0.005) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.062 | 0.087 | 0.174 | 0.001 | 0.002 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

## Reduce Visits

| | Reduce Visits = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.273*** | 0.263*** | 0.254*** | 0.023*** | 0.023*** |
| | (0.007) | (0.007) | (0.007) | (0.005) | (0.005) |
| urban | | -0.040*** | -0.040*** | | |
| | | (0.011) | (0.010) | | |
| Ln(income pc) | | 0.034*** | 0.035*** | | 0.004** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.688*** | 0.596*** | 0.551*** | 0.745*** | 0.734*** |
| | (0.006) | (0.009) | (0.034) | (0.001) | (0.005) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.065 | 0.097 | 0.157 | 0.001 | 0.001 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Change work patterns

| | Change in Work Patterns = 1; Do not =0 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| sms | 0.200*** | 0.185*** | 0.178*** | 0.036*** | 0.036*** |
| | (0.013) | (0.012) | (0.012) | (0.010) | (0.010) |
| urban | | 0.064*** | 0.061*** | | |
| | | (0.012) | (0.012) | | |
| Ln(income pc) | | 0.041*** | 0.043*** | | -0.005** |
| | | (0.002) | (0.002) | | (0.002) |
| Constant | 0.437*** | 0.297*** | 0.225*** | 0.479*** | 0.494*** |
| | (0.006) | (0.009) | (0.034) | (0.002) | (0.006) |
| Month control | No | No | Yes | FE | FE |
| Observations | 10,979 | 10,979 | 10,979 | 10,979 | 10,979 |
| R-squared | 0.026 | 0.063 | 0.120 | 0.001 | 0.002 |
| Number of hhid | | | | 1,417 | 1,417 |

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

# Appendix C - Key Questions from the L2T Survey

| Question | Options |
|---|---|
| The question: What are the main information sources you use to inform yourself about coronavirus? [RECORD ALL THAT APPLY] | 1) Television<br>2) Newspaper – print or online<br>3) Radio<br>4) Social media<br>5) Via SMS<br>6) In person – health authority<br>7) In person -- other<br>8) (Other - specify)<br>9) (Prefer not to say) |
| Have you and your household members changed any part of your normal routine(s) due to concerns about COVID-19? | 1) More hand washing<br>2) Fewer handshakes\kissing\greetings<br>3) Less\no travel<br>4) Less\no visiting local friends\relatives<br>5) Less\no working outside of the home<br>6) Wearing masks<br>7) Social distancing\staying farther away from people<br>8) Purchasing more food\other resources<br>9) Self-quarantine\Isolation potentially ill members<br>10) Other (specify) |
| Have you personally heard any instructions from officials in Government about how to reduce risks from COVID-19 in the past 7 days? | 1) Yes<br>2) No |
| If yes, how do you hear (select all that apply)? | 1) Television<br>2) Newspaper – print or online<br>3) Radio<br>4) Social media<br>5) Via SMS<br>6) In person – health authority<br>7) In person -- other<br>8) (Other - specify)<br>9) (Prefer not to say) |
| "Have you received any official SMS messages regarding COVID-19 related issues since the outbreak?" | 1) Yes<br>2) No |