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Measurement of population mental health

Evidence from a
mobile phone survey
in India



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Title: Measurement of population mental health: Evidence from a mobile phone survey in India

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Key messages

- Increasing mobile phone ownership makes mobile phone surveys a potentially valuable medium for measuring population mental health in low- and middle-income countries.
- Adaptations to simplify the Kessler-6 and the Self-Reporting Questionnaires aided measurement of mental health among mobile phone survey respondents in India.
- Compared to the adapted Kessler-6, the adapted Self-Reporting Questionnaire yielded higher response rates and more consistently identified gender differences in mental health. Both questionnaires identified regional disparities in mental health that are consistent with community studies.

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Abstract

In high-income countries, population health surveys often measure mental health. This is less common in low- and middle-income countries, including in India, where mental health is under-researched relative to its disease burden. The objective of this study is to assess the performance of two questionnaires for measuring population mental health in a mobile phone survey. We adapt the Kessler-6 screening questionnaire and the WHO's Self-Reporting Questionnaire (SRQ) for a mobile phone survey in the Indian states of Bihar, Jharkhand, and Maharashtra. The questionnaires differ in the symptoms they measure and in the number of response options offered. Questionnaires are randomly assigned to respondents. We consider a questionnaire to perform well if it identifies geographic and demographic disparities in mental health that are consistent with the prior literature and does not suffer from selective non-response. Both questionnaires measured less mental distress in Maharashtra than in Bihar and Jharkhand, which is consistent with Maharashtra's higher human development indicators. The adapted SRQ, but not the adapted Kessler-6, identified women as having worse mental health than men in all three states. Conclusions about population mental health based on the adapted Kessler-6 are likely to be influenced by low response rates (about 82% across the three samples). Respondents were different from non-respondents: non-respondents were less educated and more likely to be female. The SRQ's higher response rate (about 94% across the three states) may reflect the fact that it was developed for use in low- and middle-income countries and that it focuses on physical, rather than emotional, symptoms, which may be less stigmatized.

Introduction

In high-income countries, population health surveys often include questions on mental health in addition to physical health. For example, the National Health Interview Survey conducted by the United States Centers for Disease Control and Prevention developed the Kessler-6 scale to measure psychological distress in the U.S. population (Kessler et al 2003). The questions were later adapted for use in other settings (Kessler et al 2010). The Kessler scale and other tools to measure mental health, such as the Center for Epidemiological Studies Depression Scale (CES-D), the Generalized Anxiety Disorder (GAD) scale, and the Patient Health Questionnaire (PHQ), can be used to screen for common mental disorders in clinical settings (van Heyningen 2018, Kumar et al 2016, Patel et al 2008), and they have also contributed greatly to tracking trends in mental health in populations and to describing disparities in mental health by population groups (Case and Deaton 2017, Rosenfield and Mouzon 2013, Perreira et al 2005).

Despite the high burden of mental disorder in low- and middle-income countries (Votruba et al 2020) and the fact that the World Health Organization's Self-Reporting Questionnaire (SRQ) has been shown to be suitable for administration by lay interviewers (Harpham et al 2003), measurement of mental health in population health surveys is uncommon outside of high-income countries. The Demographic and Health Surveys' (DHS) Model Questionnaires, for instance, cover reproductive and child health, anthropometry, HIV, anemia, malaria, and chronic disease but not mental health (DHS Program 2019). Governments and international organizations might reasonably prioritize measuring physical health where mortality rates are high and infectious disease is widespread. However, as mortality and fertility rates decline and as data become decreasingly costly to collect, there are emerging opportunities to measure, understand, and address poor mental health in developing country populations.

The project of measuring population mental health in low- and middle-income countries may be facilitated by the use of mobile phone surveys, which are less costly than face-to-face surveys (Pinto-Meza et al 2005).¹ Indeed, mobile phone technology is increasingly used to deliver health information in poor countries (Pop-Eleches et al 2011, Bastawrous et al 2013). Although mobile phone surveys would have been unreliable for measuring population mental health in developing countries previously (Harpham et al 2003), increasing mobile phone ownership means that it may now be possible to do so in representative samples (Leo et al 2015), as has been done in developed countries (Kroenke et al 2009).² India's DHS finds that household-level mobile phone coverage increased dramatically from 17% in 2005 to 90% in 2015.

This paper advances the literature on the measurement of population mental health in low- and middle-income countries by testing two mental health questionnaires in a population-representative mobile phone survey conducted in three states of India. In particular, we evaluate adaptations of the Kessler-6 and the SRQ. The adaptations, which are described in detail below, made these questionnaires more suitable for use in a mobile phone survey.

¹ Although mobile phone interviewers need to be recruited, trained, and paid, there are no travel costs, which often constitute a large fraction of the budgets of population-representative surveys in developing countries (Mahfoud et al 2015).

² Studies show that results of mental health assessments by phone are highly correlated with assessments done in person (Fenig et al 1993, Pinto-Meza et al 2005, Aneshensel et al 1982).

Because phone survey methods for measuring population mental health in India are untested, we assess the performance of these two questionnaires by comparing their results to what we would expect based on prior literature on geographic and demographic variation in mental health in India. Most prior studies of mental health in India come from community studies and from efforts to screen for and diagnose mental disorders. Studies from a variety of contexts within India find that, on average, women report worse mental health than men (Patel et al 1999, Anand 2015, Mumford et al 1997, Poongothai et al 2009, Das et al 2012), that less-educated report worse mental health than more educated people (Hackett et al 2007), and that poorer people report worse mental health than richer people (Fahey et al 2016).

The paper proceeds as follows: In the Materials & Methods section, we first describe the setting in which the study was conducted; we then describe the data source: the Social Attitudes Research, India (SARI) mobile phone survey; finally, we describe how we adapted the questionnaires for use in a mobile phone survey and how we analyze the data. In the Results section we present response rates, summary statistics, and characteristics of non-response for each questionnaire; we also show the results of ordered logit regressions that describe demographic correlates of poor mental health as measured by each questionnaire. In the Discussion, we draw lessons from the Results and justify our conclusion that sufficiently simple mental health questions, such as those in the adapted SRQ, can be usefully employed to measure population mental health in phone surveys where representative sampling can be achieved.

Materials & Methods

The study setting

The states of Bihar, Jharkhand, and Maharashtra

Data for this study were collected in the Indian states of Bihar, Jharkhand, and Maharashtra. Until 2000, Bihar and Jharkhand were administered as one state (Bihar). Both states have similar geographic sizes but very different population sizes: the 2011 Census found a population of about 100 million in Bihar, compared to 32 million in Jharkhand. The 2011 population of Maharashtra was approximately 112 million in a land area three times as large as Bihar.

People in Maharashtra are healthier, have fewer children, are better educated, and are richer than people in Bihar and Jharkhand. India's 2017 Sample Registration System (SRS) Statistical Report reports infant mortality in Maharashtra at 19 per 1000 live births, compared with 35 in Bihar and 29 in Jharkhand. Similarly, child mortality (ages 1-5) is 9 per 1000 live births in Bihar and 8 in Jharkhand, but just 4.3 in Maharashtra. Additionally, the SRS reports a Total Fertility Rate in Maharashtra of 1.7, while it is 3.2 in Bihar and 2.5 in Jharkhand. According to the 2015/16 National Family Health Survey (NFHS), the average adult in Maharashtra has 7.6 years of education, but only 4.8 years in Bihar and 5.6 years in Jharkhand. Further, the 2011 Indian Census reported a literacy rate for Maharashtra of 83%, compared to 64% in Bihar and 68% in Jharkhand. India's Ministry of Statistics and Program Implementation reports the 2018-19 annual net state domestic product per capita to be ₹191,736 for Maharashtra, compared to ₹43,822 for Bihar and ₹76,019 for Jharkhand (MoSPI, 2019).

The SARI data, which is described below, finds geographic variation in the prevalence of caste and gender discrimination. The fraction of upper-caste adults who reported practicing untouchability – a

severe form of discrimination against people from the lower castes³ -- was 25% [95% CI: 21%,30%] in Maharashtra, compared to 48% [95% CI: 45%, 51%] in Bihar, and 37% [95% CI: 31%, 44%] in Jharkhand. One important measure of household-level gender discrimination in India is whether women eat meals only after men have finished eating. SARI finds that women usually eat last in 31% [95% CI: 28%, 34%] of households in Maharashtra, compared to 70% [95% CI: 68%, 72%] of households in Bihar and 53% [95% CI: 48%, 58%] in Jharkhand.

Evidence from prior studies on correlates of poor mental health in India

Recognizing that mental health disorders are a growing concern, India's Ministry of Health and Family Welfare commissioned a national survey to understand the prevalence and pattern of mental disorders. The 2015-16 National Mental Health Survey collected data across 12 states from 39,532 individuals and found that common mental disorders such as depression, anxiety, and substance use disorders affect nearly 10% of the population (Gururaj et al 2016). However, many community-level studies find much higher rates of poor mental health (Panigrahi et al 2014, Pothan et al 2003).

Significant social and economic inequality exists in India today, suggesting that we are likely to find important disparities in the prevalence of common mental disorders. We expect to see better mental health among men compared to women: across countries, gender disadvantage of multiple forms, including limited access to resources, restricted choices, and discrimination have been shown to have negative effects on mental health for women (Chandra and Satyanarayana 2010). We also expect that lower education and fewer assets will have a negative correlation with mental health outcomes. A lack of education may be an indication of childhood adversity, low social status, or a lack of opportunity, which may in turn hurt mental health (Araya et al 2003). Poverty may put individuals at greater risk of developing mental health disorders because of social exclusion, high levels of stress, and higher likelihood of experiencing adverse events that lead to insecurity (Lund et al 2010, Patel and Kleinman 2003, Das et al 2007).

Evidence is also emerging that low-caste groups and Muslims, India's largest minority religion, have worse mental health than individuals from higher-status groups (Gupta and Coffey 2019). A study from Uttarakhand, a state in north India, found that low-caste individuals were more likely to report having depression than high-caste individuals (Mathias et al 2015). And in a study of five north-Indian states, Spears (2016) finds that Dalits, those of the lowest caste, report worse life satisfaction than any other caste, even controlling for education and asset wealth.

We expect that mental health indicators in Maharashtra will be better than those in Bihar and Jharkhand because Maharashtra fares much better across socioeconomic characteristics, health statistics, and the extent of gender and caste discrimination.

³ Caste hierarchies, based on fixed occupational roles with corresponding levels of ritual purity and social ranking (Vaid 2014), play an important role in Indian society. Untouchability is a severe form of discrimination against Dalits, or the lowest caste in the Indian caste system. Traditionally expected to perform tasks considered dirty and impure, they were called "untouchable" as contact with them was considered to be polluting. Even today, this work is used to justify widespread oppression of Dalit communities (Shah et al 2006).

The SARI survey

We use data from the SARI survey. SARI is a mobile phone survey designed to measure attitudes towards marginalized groups, including women, lower castes, and Muslims, and to measure opinions about public policies in India. Prior to collecting data on adults in Bihar, Jharkhand, and Maharashtra, SARI collected data in Delhi and Uttar Pradesh (2016), and Rajasthan and Mumbai (2017). The Bihar, Jharkhand, and Maharashtra samples introduced questions on health -- particularly on abortion (Broussard et al 2019) and mental health -- to the SARI survey.

The SARI survey builds representative samples by using probability-weighted random digit dialing and within-household respondent selection. Specifically, we provide interviewers a list of phone numbers: The first five digits are codes that Telecom Regulatory Authority of India (TRAI) issues to mobile phone companies based on the geographic mobile circle from which the number originates, and the last five digits are randomly generated. The number of times a particular five-digit code appears in the list is proportional to the number of subscriptions that mobile companies report to the TRAI.

SARI interviewers call these phone numbers in a random order, and speak to respondents of the same sex. The reason interviews speak to someone of the same sex is that respondents tend to be more comfortable talking to people of the same sex. Once a respondent of the interviewer's same sex agrees to participate, they are asked to list all adults of their sex in the household. Survey respondents are selected randomly from the household listing by Qualtrics software to ensure (1) that even individuals who do not own their own mobile phones are eligible to be interviewed and (2) that even the least educated adults, who may be less likely to participate in a phone survey, are represented in our sample.

Table 1 shows SARI sample sizes and response rates by state. Although SARI's response rates may appear low compared to response rates typically seen in face-to-face interviews, they are quite high compared with phone surveys done in other countries. A Pew Research Center study from the United States (Kohut et al 2012) found an average response rate of 9% in its 2012 surveys. They concluded that weighting phone survey data to match the demographic composition of the population can sufficiently adjust for low response rates and that phone surveys can provide accurate estimates of public opinion. SARI's sample sizes are consistent with other representative samples used to analyze social attitudes.

[TABLE 1]

NFHS 2015/16 data suggest that low mobile phone ownership is unlikely to present a major obstacle to achieving a representative sample in this context. Table 2 shows the fraction of households in each state that own a mobile phone. Coverage in Bihar and Maharashtra is similar at approximately 90% and 91% respectively, while coverage in Jharkhand is lower, at 84%. Urban areas across all three states have higher coverage than rural areas, with the greatest urban-rural difference in Jharkhand.

[TABLE 2]

Even though SARI's respondent selection strategy tries to ensure that individuals with lower levels of education are represented in the sample, less educated or rural adults may be less likely to keep their phones on, and they may be less likely to agree to participate in the survey. SARI interviewers are trained to address possible under-representation of the least educated adults. Nevertheless, distributions of education among adults in the SARI survey and in the 2011 Census available in

Supplementary Appendix Figure 1A show that SARI under-represented less educated respondents in the raw sample.

To account for different response rates of demographic groups, we construct and use survey weights based on the sex, age, place, and education distributions of the population. Sample statistics are representative of the state population if, conditional on sex-by-age-by-education bins, respondents' answers are similar to answers that would have been given by people who were not reached or who refused.

To improve the quality of the sample and to reduce social desirability bias, interviewers interview respondents of the same sex. To reduce non-sampling errors, interviewers use caste- and religion-neutral names, refrain from showing approval or disapproval for respondent answers, and take care to explain the study's purpose. Coffey et al (2018) assess the quality of SARI data by comparing it to data from the Indian Human Development Survey (IHDS), a face-to-face survey of over 40,000 households: SARI's state-level estimates of practices of discrimination against women and Dalits are not statistically distinguishable from the IHDS', which points to the high quality of the SARI data.

SARI data and documentation are publicly available at <http://riceinstitute.org>.

Adaptations of Kessler-6 and Self-Reporting Questionnaires

The Kessler-6 questionnaire was developed for use in the United States with the goal of creating a short set of questions that could provide accurate estimates of mental illness. It was designed to measure psychological distress based on answers to six questions related to a respondent's emotional state (Kessler et al 2003). The Kessler-6 has been validated through the World Mental Health Survey Initiative for low- and middle-income country contexts (Kessler et al 2010, Tesfaye et al 2010), confirming that responses to the Kessler-6 match well with independent clinical assessments of mental illness.

For each question, respondents are asked to report whether, in the 30 days prior to the interview, they experienced a negative feeling all of the time, most of the time, some of the time, a little of the time, or none of the time. Each question is scored from five to zero, with higher numbers indicating worse mental health. Because there are six questions, the range of possible scores is from 0 to 30.

The Self-Reporting Questionnaire (SRQ) was developed by the WHO for use by primary health workers with limited training in low- and middle-income country settings (Beusenbergh and Orley 1994). It includes 20 questions that focus on physical symptoms that are easy to understand, and a "yes" or "no" response format. Researchers have adapted the SRQ to a variety of settings and have validated that it is able to detect common mental disorders across cultural contexts with reasonable accuracy (Youngmann et al 2008, Giang et al 2006, de Jesus Mari and Williams 1986, Chen et al 2009, Husain et al 2006).

Respondents to the SARI survey were randomly assigned to receive either an adapted Kessler-6 questionnaire or an adapted SRQ. We describe the adaptations to these questions here. Both sets of mental health questions appeared after questions on asset and latrine ownership.

SARI interviewers introduced Kessler-6 questions with the following text: "We do not always feel the same way. Sometimes we are sad and sometimes we are happy, sometimes we are worried and sometimes relaxed. In the next few questions, I will ask how you have been feeling in the past one month." This is a slight elaboration on the original text: "The next questions are about how you have

been feeling in the past 30 days.” Our experiences of piloting the Kessler-6 suggested a longer introduction would be useful because respondents were confused when the interviewer abruptly changed from asking about the assets in their household to asking about their feelings.

The original (unadapted) Kessler-6 questions are listed in Table 3. When the Kessler-6 is administered verbally, the interviewer reminds the respondent of the 30-day reference period and the five answer options for each question.

[TABLE 3]

We initially piloted Hindi translations of the Kessler-6 questions in a face-to-face setting. After revising the translation, we piloted the questions over the phone. Many respondents were not able to keep track of five response options, which led to high rates of non-response. However, when the number of response options was reduced from five to three, more respondents were able to answer. Therefore, the SARI survey maintained the same questions asked by the Kessler-6 but adapted the options from “all of the time,” “most of the time,” “some of the time,” “a little of the time,” or “none of the time” to “always,” “sometimes,” or “never.” Whereas studies that use the five-option scale often present results on a scale of 0 to 24, our results for the adapted Kessler-6 are on a scale of 0 to 12 possible points, where lower numbers represent better mental health.

In SARI, the SRQ questions were introduced with the following text: “In the next few questions, I will ask you about the sadness or problems you may have faced in the last 30 days. If something like this happened in the last 30 days, say yes. If this did not happen in the last 30 days, say no. Now I will ask you questions one-by-one.” This is the same text as is recommended by Beusenbergh and Orley (1994) in the *User’s Guide to the Self Reporting Questionnaire* published by the WHO.

Similar to the Kessler-6 questions, Hindi translations of the SRQ were first piloted face to face and then by phone. Over the phone, many respondents became confused or frustrated by the similarity across the SRQ questions. To reduce attrition and to achieve a closer comparison with the Kessler-6 Questionnaire, we included six out of the original 20 SRQ questions in our adapted SRQ Questionnaire. The questions we chose focused on physical (rather than emotional) experiences to provide a contrast to the way that the Kessler-6 assesses mental health. Table 3 lists the full set of SRQ questions. Those used in the SARI survey are marked with an asterisk. We hypothesized that respondents might more readily talk about what they saw as physical experiences, rather than about emotional ones. Although the literature has validated self-reports of physical symptoms as a way of assessing mental health (Tylee and Gandhi 2005, Kapfhammer 2006), our respondents may not have known that these questions were intended to measure mental health.

Respondents who were assigned the SRQ typically answered the questions more easily than those who were assigned the Kessler-6 questionnaire. Our experiences from piloting and speaking with interviewers suggest that this is because answers to the SRQ are in a “yes” or “no” format.

Analysis of response rates

To analyze response rates for the two questionnaires, we compute weighted proportions of people who answered all of the mental health questions, some, and none. The construction of survey response weights is described above. Respondents who answered the asset section prior to the mental health section are considered eligible to answer mental health questions. They are included in the

denominator for the purpose of computing the response rate. Respondents who began the survey but stopped participating before the household asset section are not included in the denominator.

Analysis of selection into non-response

To examine whether respondents with certain characteristics are more likely to not respond to each set of mental health questions, we use single-variable OLS linear probability models to regress an indicator for non-response on demographic characteristics, separately for respondents who were assigned to each questionnaire. For this analysis, we combine data from all three states and use pooled weights. The OLS model we use is of the following form:

$$non - response_i = \beta_1 demographic\ characteristic_i + \varepsilon_i$$

Where i indexes the individual. The dependent variable is the likelihood of a respondent leaving all or some of the mental health questions unanswered for the questionnaire that the respondent was randomly assigned to answer. We run separate regressions for the following independent variables: (1) whether the respondent is female, (2) whether the respondent is over age 45, (3) whether the respondent has less than 9 years of education, and (4) whether the respondent owns 2 or fewer assets.

Analysis of mental health outcomes

For both the adapted Kessler-6 questionnaire and the adapted SRQ, the primary measure of mental health that we analyze is a mental health score. For the adapted Kessler-6, respondent mental health scores range from 0 to 12, as described above. For the adapted SRQ, the mental health score is the sum of indicator variables for having answered “yes” to an SRQ question. Therefore, the SRQ scores range from 0 to 6. These scores are the main dependent variables of interest for our analyses.

We examine predictors of mental health score for each of the questionnaires as a means of assessing the quality of the questions for measuring mental health in this context. Our choice of predictor variables is informed by the prior literature described above.

The mental health scores are ordered variables; therefore, we analyze the correlates of poor mental health using ordered logit regression. In an ordered logit model, a latent variable m^* is assumed to be a linear function of the independent variables, with an error term with a logistic distribution. The ordered outcome *categories* correspond to *cut-points* in the continuous distribution of m^* that are unobservable parameters fit by maximum likelihood (Rodriguez 2007). Ordered logit regression analysis allows us to investigate which characteristics predict mental health among respondents from each questionnaire. One disadvantage of the ordered logit approach, however, is that it constrains the covariates to have the same linear effect on latent mental health at each cut point.

We write the linear model for m^* as:

$$m_i^* = \beta_1 female_i + Age\ group_i \theta + Education\ group_i \Gamma + \beta_2 Muslim_i + Caste\ group_i \Lambda + \beta_3 count\ of\ assets_i + \varepsilon_i$$

where ε_i has a logistic distribution and the ordered logit link function additionally includes cut-points for levels of the outcome variable. Subscripts i index respondents. $female_i$ is an indicator for whether person i is female; $Age\ group_i$ is a set of four dummy variables for the age of the respondent, in years; $Education\ group_i$ is a set of four indicators for educational attainment; $Muslim_i$ is an indicator for being Muslim; $Caste\ group_i$ is a set of five indicators for whether a respondent is Scheduled Caste, Other Backward Class, Scheduled Tribe, general caste, or Brahmin; $count\ of\ assets_i$ is the number of assets (out of five) that the respondent's household owns. The assets that the SARI survey asks about are mixers, scooters, fans, refrigerators, and pressure cookers. We do not show separate coefficients for each caste group because some caste groups are quite small. Instead, we show the results of an F -test of the statistical significance of all of the caste indicators in predicting mental health score.

Results

Summary statistics about respondents

Table 4 summarizes respondent characteristics. Summary statistics are reported by state and by mental health questionnaire. As we would expect based on state-level differences in human development, there are differences in schooling and asset ownership across states: respondents in Bihar and Jharkhand are less educated than those in Maharashtra and own fewer assets, on average. Bihar and Jharkhand also have higher proportions of Muslim and lower caste respondents than Maharashtra. There are not meaningful differences in the characteristics of respondents who answered each type of questionnaire because questionnaires were randomly assigned to respondents. Any differences in measured mental health across questionnaires can be attributed to differences in the questionnaire rather than to differences in respondent characteristics.

[TABLE 4]

Response rates and selection into non-response

Table 5 shows marked differences in response rates for the adapted Kessler-6 questionnaire and the adapted SRQ. In each state, the proportion of respondents who answered all mental questions was statistically significantly lower if assigned the Kessler-6 than if assigned the SRQ. In the pooled sample, the response rate was 82% for the Kessler-6, compared to 94% for the SRQ. In Bihar, the proportion of respondents who responded to all mental health questions was 17 percentage points higher for SRQ than for Kessler-6; in Jharkhand, the difference was 16 percentage points; and in Maharashtra, the difference was 12 percentage points. We note that these disparities are coming mostly from differences in partial response, rather than respondents refusing or being unable to answer all mental health questions.

[TABLE 5]

Table 6 shows that the Kessler-6 suffers from a greater degree of selective non-response than the SRQ. The results in Table 6 show that there is selection into non-response to the Kessler-6 questionnaire on respondent sex, age, education, and asset ownership: women are 7 percentage points more likely to give non- or partial responses to the Kessler-6 questionnaire than men, older adults (ages 45-65) are 3 percentage points more likely to be non-respondents than younger adults, those with less education (fewer than 8 years) are 10.6 percentage points more likely to be non-respondents, and those who live

in households with fewer than 2 assets (out of 5) are 7.9 percentage points more likely to be non-respondents, holding the other factors constant. In contrast, the only characteristic that statistically significantly predicts non-response to the SRQ is asset ownership, and the magnitude of the relationship is small compared to the Kessler-6 questionnaire: those who live in households with fewer than 2 assets (out of 5) are only about 2 percentage points more likely to be non-respondents.

[TABLE 6]

Summary statistics for mental health measurements

Figure 1 shows the proportion of respondents who report each symptom in each state, with 95% confidence intervals. To compare results from the adapted Kessler-6 questionnaire to results from the adapted SRQ, we collapse the answers to the Kessler-6 questions into a dichotomized variable that takes on “1” if the respondent experienced the symptom “sometimes” or “most of the time” in the 30 days before the survey and “0” if he or she “never” experienced the symptom in the 30 days before the survey. This coding appears to find that respondents to the Kessler-6 have worse average mental health than those who responded to the SRQ. However, levels of mental health cannot be directly compared across the two questionnaires because the coding of responses is not analogous.

[FIGURE 1]

One thing that stands out from Figure 1 is that, for almost every symptom, people in Maharashtra report statistically significantly better mental health than people in Jharkhand and Bihar. This makes sense considering the differences across the states in human development.⁴

To further investigate differences across states in reported mental health, Figure 2 plots cumulative distribution functions (CDFs) of mental health scores (described above) by state for each questionnaire. The finding that respondents in Maharashtra have better mental health from Figure 1 is also evident in Figure 2. For both the Kessler-6 and the SRQ, the CDF for Maharashtra is always to the left of those for Bihar and Jharkhand. The CDFs for Bihar and Jharkhand are similar for both questionnaires. The Jharkhand CDF stochastically dominates the Bihar CDF for the SRQ, but the CDFs cross for Kessler-6.

[FIGURE 2]

Correlates of poor mental health

We investigate whether the demographic differences in mental health found in the prior literature, described above, are present in the questionnaires we study. Figure 3 shows histograms of mental health score by sex of respondent for each questionnaire in each state. It is visually apparent that in each state, the SRQ classifies women as having worse mental health than men. This is also true of the

⁴ The fraction of respondents who reported that they had thought of ending their own life in the 30 days prior to the survey is very high. Interviewers acknowledged when a respondent reported yes to this question and responded by saying, “I am sad to hear you say that. We hope that you will begin to feel good again soon.” However, they did not probe further. And since many rural districts lack qualified mental health providers, referrals were not made. We hope to follow up with deeper qualitative work to understand how respondents interpreted this question, and if prevalence is so high in reality.

Kessler-6 questionnaire in Bihar, but differences between men and women are not as visually apparent for the Kessler-6 in Jharkhand and Maharashtra.

[FIGURE 3]

Table 7 presents the results of ordered logit regressions of mental health score on demographic characteristics. Coefficients are presented as odds ratios, and standard errors are given in parentheses. Table 7 shows that, with the exception of the Kessler-6 questionnaire in Jharkhand and Maharashtra, being female statistically significantly predicts worse mental health. We note that the magnitude of the coefficient on *female* for Kessler-6 in Jharkhand is similar to the one for Kessler-6 in Bihar, but the sample size is much smaller. Collecting a larger sample of respondents in Jharkhand may have permitted us to identify a statistically significant difference between men's and women's mental health using the Kessler-6 questionnaire. Pooled results for both Kessler-6 and SRQ show that being female is a statistically significant predictor of poor mental health.

[TABLE 7]

With the exception of the Kessler-6 in Jharkhand, asset ownership statistically significantly predicts better mental health in all samples, including in the pooled sample. Controlling for assets, people with more schooling typically have lower odds of reporting poor mental health. Across states, the difference between a person with no education and one with 13 or more years of education is more consistently apparent in the SRQ than in the Kessler-6 but is statistically significant for both questionnaires in the pooled sample. Perhaps surprisingly, caste and religion do not predict poor mental health in any of the samples. We discuss these findings below.

Discussion

This paper measures mental health in three states in India using existing questionnaires adapted for a mobile phone survey. Because questionnaires are randomly assigned to respondents, any differences can be attributed to the questions themselves rather than to respondent characteristics. In this section, we reflect on what we learned about measuring population mental health from piloting, adapting, and implementing these questionnaires and from analyzing the results.

Mental health questions are more challenging to ask than other questions in the survey, which measured personal characteristics, social attitudes, and opinions about public policy. Interviewers report having to spend more effort to avoid hang-ups and other forms of non-response during the mental health questions than on any other question. Mental health questions related to emotions, such as those in the Kessler-6 questionnaire, often require interviewers to give substantial explanations about what the question is asking, which slows the survey and frustrates respondents.

However, respondents are more forthcoming with answers to questions related to physical symptoms, such as those in the adapted SRQ. We hypothesize, but have not tested, that the physical symptoms in the SRQ are more likely to be part of day-to-day conversations than the emotional symptoms in the Kessler-6. In addition, there may be stigma associated with expressing emotional problems. This is consistent with Raguram et al.'s (1996) study that finds that patients in Bangalore view reporting depressive symptoms, but not somatic symptoms, as socially disadvantageous because physical symptoms seem similar to illnesses that even people in good mental health could experience. Similarly,

Pereira et al (2007) show that women diagnosed with depression expressed their problems primarily through somatic complaints.

Of course, we cannot separate the effect of measuring mental health with questions related to emotion from the fact that the Kessler-6 questionnaire is different in other ways too. It gives three response options, in contrast to the two offered by the SRQ. SARI interviewers report that three answer options were often difficult for respondents to remember. It is possible more respondents would have answered Kessler-6 questions if they could have responded in a “yes” or “no” format. Doing so, however, would have made this study less comparable with prior studies that use the Kessler-6 questionnaire. Future experiments on mental health measurement in low- and middle-income countries that use mobile phone surveys might usefully test this adaptation to the Kessler-6 questionnaire.

The difficulty that interviewers and respondents had with the Kessler-6 questions is evident in the lower response rates and in the selection into non-response. Respondents’ gender and education play an important role in who completes the Kessler-6 questions. The fact that response rates for Kessler-6 are statistically significantly higher in Maharashtra than in Bihar and Jharkhand is consistent with the fact that respondents in Maharashtra have more education, on average, than respondents in the other states. Considering that women and people with less education are typically vulnerable to worse mental health, it may be advisable to avoid phone survey measurements of population mental health with Kessler-6, or similar multi-response option, emotion-based questionnaires, in low- and middle-income countries until these populations are found to respond at similar rates to men and more educated people.

The lack of correlation between caste and religion and mental health in the SARI data is perhaps surprising. We do not find that Muslims, who experience social discrimination in India, report worse mental health than Hindus. To our knowledge, there is only one population-level study of mental health among Muslims in India (Gupta and Coffey 2019), which uses WHO-SAGE data to show that, even accounting for socioeconomic characteristics, Muslims have worse mental health than Hindus. They also find that Scheduled Castes have worse mental health than upper-caste Hindus. The absence of similar associations in SARI may be due to small sample sizes or the fact that different questions were asked. The relationship between poor mental health and minority status in India merits further investigation: surveys with both larger samples and a wider array of mental health questions are needed to better understand how membership in different caste and religious groups relates to mental health in India.

Conclusion

In sum, we find that the adapted Self-Reporting Questionnaire (SRQ), which focuses on physical symptoms instead of emotions, has higher response rates in all three states than the adapted Kessler-6 questionnaire. Conclusions about population mental health computed from the adapted Kessler-6 questionnaire are likely to be influenced by the fact that those who responded were different from those who did not. Consistent with the prior literature, both questionnaires classified mental health in Bihar and Jharkhand as markedly worse than in Maharashtra. However, only the SRQ identified women as having worse mental health than men in all three states. The SRQ also more often identified disparities by education.

These findings contribute to health researchers' efforts to measure levels, trends, and disparities in the mental health of populations in two ways. First, they show that mobile phone surveys may provide a valuable medium for incorporating mental health measurement into population level surveys. Second, they show that it may be better to ask about physical symptoms, as in the adapted SRQ, rather than emotional ones, as in the adapted Kessler-6.

Future research might combine both types of questions into a single questionnaire. This would allow researchers to see whether the same respondents are classified as having poor mental health by various question types. It is an important and urgent goal to include appropriate mental health questions in nationally representative population health surveys to advocate for better mental health services and track changes in mental health. Although there is still work to be done in refining a meaningful set of questions, phone surveys may be an increasingly valuable tool in this endeavor.

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Table 1. SARI sample sizes and response rates, by state

State	<u>Sample sizes</u>			<u>Response rates</u>
	Men	Women	Total	(%)
Bihar	1450	1988	3438	19
Jharkhand	459	550	1009	
Maharashtra	920	746	1666	25
Total	2829	3284	6113	

Note: Survey response rates are calculated as the number of surveys in which a respondent answered at least a third of the questions divided by the number of mobile numbers that were valid (as opposed to nonexistent, switched off, or not available) when they were first called. Response rates for Bihar and Jharkhand cannot be calculated separately because Bihar and Jharkhand mobile numbers are pooled into the same mobile circle by the Telecom Regulatory Authority of India. State of residence is only known for individuals who began the survey, but not for every valid phone number called.

Table 2. Household-level mobile phone ownership, by state

State	Urban (%)	Rural (%)	Total (%)
Bihar	95	89	90
Jharkhand	95	80	84
Maharashtra	97	86	91
Total	96	87	90

Note: Data source: National Family Health Survey, 2015-16.

Table 3. Original questions asked in Kessler-6 and Self-Reporting Questionnaires

Kessler-6 Questionnaire	Self-Reporting Questionnaire
1. About how often during the past 30 days did you feel nervous -- would you say all of the time, most of the time, some of the time, a little of the time, or none of the time? 2. About how often during the past 30 days did you feel hopeless -- would you say all of the time, most of the time, some of the time, a little of the time, or none of the time? 3. About how often during the past 30 days did you feel restless or fidgety -- would you say all of the time, most of the time, some of the time, a little of the time, or none of the time? 4. About how often during the past 30 days did you feel so depressed that nothing could cheer you up -- would you say all of the time, most of the time, some of the time, a little of the time, or none of the time? 5. About how often during the past 30 days did you feel that everything was an effort -- would you say all of the time, most of the time, some of the time, a little of the time, or none of the time? 6. About how often during the past 30 days did you feel worthless -- would you say all of the time, most of the time, some of the time, a little of the time, or none of the time?	1. Do you often have headaches? 2. Is your appetite poor?* 3. Do you have trouble sleeping?* 4. Are you easily frightened? 5. Do your hands shake? 6. Do you feel nervous, tense, or worried? 7. Is your digestion poor? 8. Do you have trouble thinking clearly?* 9. Do you feel unhappy? 10. Do you cry more than usual? 11. Do you find it difficult to enjoy your daily activities? 12. Do you find it difficult to make decisions?* 13. Is your daily work suffering? 14. Are you unable to play a useful part in life? 15. Have you lost interest in things? 16. Do you feel that you are a worthless person? 17. Has the thought of ending your life been on your mind?* 18. Do you feel tired all the time?* 19. Do you have uncomfortable feelings in your stomach? 20. Are you easily tired?

Note: Source for Kessler-6 Questionnaire: National Comorbidity Survey:

https://www.hcp.med.harvard.edu/ncs/k6_scales.php. Source for SRQ: A User's Guide to the Self-Reporting Questionnaire (Beusenbergh and Orley 1994)

Table 4. Summary statistics for predictors of mental health score, by state

	<u>Bihar</u>				<u>Jharkhand</u>				<u>Maharashtra</u>				<u>Total</u>			
	Kessler		SRQ		Kessler		SRQ		Kessler		SRQ		Kessler		SRQ	
	prop.	s.e.	prop.	s.e.	prop.	s.e.	prop.	s.e.	prop.	s.e.	prop.	s.e.	prop.	s.e.	prop.	s.e.
female	0.46	0.01	0.46	0.01	0.50	0.03	0.50	0.02	0.47	0.02	0.48	0.02	0.47	0.01	0.47	0.01
education																
no schooling	0.47	0.01	0.46	0.01	0.39	0.03	0.47	0.02	0.24	0.02	0.23	0.02	0.34	0.01	0.35	0.01
1-8 years schooling	0.26	0.01	0.28	0.01	0.32	0.02	0.22	0.02	0.36	0.02	0.35	0.02	0.32	0.01	0.30	0.01
9-12 years schooling	0.19	0.01	0.17	0.01	0.19	0.02	0.19	0.02	0.26	0.02	0.28	0.02	0.23	0.01	0.22	0.01
13+ years schooling	0.08	0.01	0.09	0.01	0.10	0.02	0.12	0.01	0.14	0.01	0.15	0.01	0.12	0.01	0.12	0.01
age group																
18-24	0.22	0.01	0.24	0.01	0.20	0.02	0.26	0.02	0.23	0.02	0.23	0.02	0.22	0.01	0.24	0.01
25-34	0.29	0.01	0.29	0.01	0.33	0.02	0.23	0.02	0.28	0.02	0.26	0.02	0.29	0.01	0.26	0.01
35-44	0.21	0.01	0.24	0.01	0.19	0.02	0.24	0.02	0.22	0.02	0.23	0.02	0.21	0.01	0.24	0.01
45-65	0.29	0.01	0.23	0.01	0.27	0.02	0.28	0.02	0.27	0.02	0.28	0.02	0.28	0.01	0.26	0.01
caste category																
Scheduled Caste	0.17	0.01	0.18	0.01	0.14	0.02	0.16	0.02	0.12	0.01	0.16	0.01	0.14	0.01	0.17	0.01
Other Backward Caste	0.5	0.01	0.52	0.01	0.46	0.03	0.44	0.02	0.37	0.02	0.33	0.02	0.43	0.01	0.42	0.01
General	0.23	0.01	0.21	0.01	0.17	0.02	0.17	0.02	0.34	0.02	0.41	0.02	0.28	0.01	0.30	0.01
Brahmin	0.07	0.01	0.06	0.01	0.06	0.01	0.05	0.01	0.02	0.01	0.02	0.00	0.04	0.00	0.04	0.00
Scheduled Tribe	0.03	0.00	0.02	0.00	0.18	0.02	0.17	0.02	0.12	0.01	0.07	0.01	0.09	0.01	0.06	0.00
Other	0.00	0.00	0.00	0.00	0.00	.	0.02	0.01	0.03	0.01	0.02	0.01	0.02	0.00	0.01	0.00
religion																
Hindu	0.80	0.01	0.84	0.01	0.76	0.02	0.72	0.02	0.88	0.01	0.88	0.01	0.83	0.01	0.84	0.01
Muslim	0.20	0.01	0.16	0.01	0.16	0.02	0.24	0.02	0.09	0.01	0.07	0.01	0.14	0.01	0.13	0.01
Other	0.00	0.00	0.00	0.00	0.08	0.01	0.04	0.01	0.04	0.01	0.05	0.01	0.03	0.00	0.03	0.00
asset count (mean, out of 5)	2.14	0.04	2.07	0.04	2.50	0.10	2.27	0.08	3.52	0.05	3.69	0.05	2.89	0.03	2.86	0.03
n	1287		1471		362		460		723		750		2372		2681	

Note: Observations are adults whose mental health was measured. Weighted proportions and standard errors are shown. For asset count, the mean number of assets in the household (out of 5) is shown. Data are analyzed separately by questionnaire to show that random assignment of questionnaires produced statistically similar samples. For the last three 'Total' columns, data for all three states are combined, with estimates using pooled weights.

Table 5. Response rates to adapted Kessler-6 and Self-Reporting Questionnaires

state	adapted Kessler-6 questionnaire			<i>n</i>
	answered all questions	answered some questions	answered no questions	
Bihar	0.76 [0.72, 0.79]	0.18 [0.15, 0.21]	0.06 [0.05, 0.08]	1676
Jharkhand	0.73 [0.66, 0.79]	0.19 [0.14, 0.25]	0.08 [0.05, 0.14]	466
Maharashtra	0.87 [0.83, 0.90]	0.06 [0.04, 0.10]	0.07 [0.04, 0.10]	820
Total	0.82 [0.79, 0.84]	0.11 [0.10, 0.14]	0.07 [0.05, 0.09]	2964

state	adapted Self-Reporting Questionnaire			<i>n</i>
	answered all questions	answered some questions	answered no questions	
Bihar	0.93 [0.91, 0.94]	0.03 [0.02, 0.05]	0.04 [0.03, 0.05]	1619
Jharkhand	0.89 [0.84, 0.93]	0.04 [0.02, 0.07]	0.07 [0.04, 0.11]	500
Maharashtra	0.95 [0.93, 0.97]	0.01 [0.01, 0.03]	0.03 [0.02, 0.05]	784
Total	0.94 [0.93, 0.95]	0.02 [0.02, 0.03]	0.03 [0.03, 0.05]	2903

Note: Weighted proportions are shown. 95% confidence intervals are shown in brackets. Sample sizes show the number of respondents considered eligible to respond to a particular questionnaire. A respondent is considered eligible if he/she answered the prior question and was randomly assigned to be asked that questionnaire. For the 'Total' rows, data for all three states are combined, with estimates using pooled weights.

Table 6. Selection into non-response to adapted Kessler-6 and Self-Reporting Questionnaires, all states

	<u>Kessler-6</u>	<u>SRQ</u>
female	0.0696*** (0.0141)	-0.0103 (0.00868)
older adult (age 45-65)	0.0354* (0.0157)	0.00159 (0.00983)
less than secondary education (0-8 years)	0.106*** (0.0151)	0.00412 (0.00911)
have 2 or fewer assets (of 5)	0.0790*** (0.0144)	0.0196* (0.00885)
<i>n</i>	2964	2903

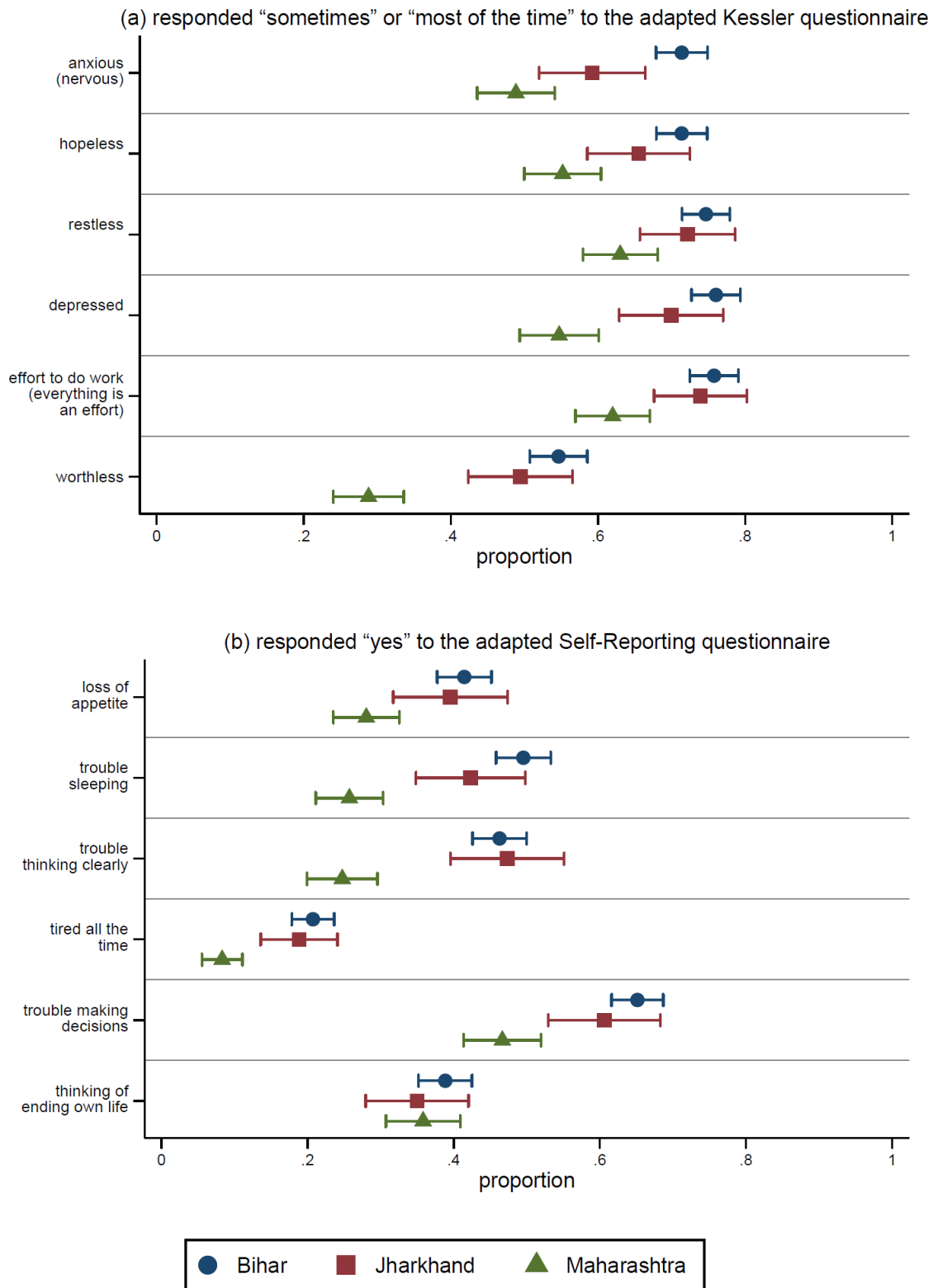
Note: The table shows coefficients and standard errors for single-variable OLS linear probability models predicting non-response to the mental health questions among those who were randomly assigned to answer that set of questions and who had answered the previous section. Standard errors are given in parentheses: + $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$. Data for all three states are combined, and all regressions use pooled weights.

Table 7. Ordered logistic regressions predicting mental health score

	Bihar		Jharkhand		Maharashtra		Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Kessler	SRQ	Kessler	SRQ	Kessler	SRQ	Kessler	SRQ
female	1.498*	1.914***	1.499	2.460***	1.161	1.733**	1.277+	1.839***
	(0.251)	(0.311)	(0.445)	(0.667)	(0.241)	(0.367)	(0.172)	(0.247)
age 18-24								
age 25-34	1.406+	0.787	0.958	0.933	1.967**	0.977	1.638**	0.900
	(0.280)	(0.181)	(0.364)	(0.418)	(0.515)	(0.269)	(0.298)	(0.158)
age 35-44	1.323	0.996	1.240	1.010	1.585	0.904	1.441	0.953
	(0.270)	(0.223)	(0.480)	(0.442)	(0.537)	(0.253)	(0.328)	(0.170)
age 45-65	1.685*	1.298	0.826	1.156	1.885*	0.716	1.655*	0.906
	(0.397)	(0.317)	(0.341)	(0.556)	(0.574)	(0.191)	(0.353)	(0.164)
no school								
1-8 years	0.939	1.291	1.164	0.512	1.687	0.853	1.116	0.956
	(0.192)	(0.271)	(0.410)	(0.241)	(0.547)	(0.270)	(0.219)	(0.184)
9-12 years	0.745	0.596*	1.184	0.627	1.139	0.691	0.856	0.672*
	(0.136)	(0.135)	(0.401)	(0.226)	(0.359)	(0.182)	(0.160)	(0.112)
13+ years	0.513**	0.529*	1.108	0.617	0.774	0.599+	0.622*	0.627*
	(0.116)	(0.138)	(0.457)	(0.270)	(0.273)	(0.181)	(0.141)	(0.122)
Muslim	1.092	1.289	0.798	0.708	0.817	1.097	1.081	1.245
	(0.303)	(0.276)	(0.563)	(0.273)	(0.283)	(0.307)	(0.247)	(0.203)
F-statistic on caste indicators	6.86	2.03	8.15	8.19	0.97	13.28	3.20	8.18
p-value on caste indicators	0.23	0.84	0.09	0.14	0.96	0.02	0.67	0.15
number of assets (of 5)	0.885*	0.824***	0.954	0.811*	0.837*	0.808**	0.795***	0.764***
	(0.0466)	(0.04433)	(0.0774)	(0.0769)	(0.0703)	(0.0648)	(0.0344)	(0.0326)
n	1287	1471	362	460	723	750	2372	2681

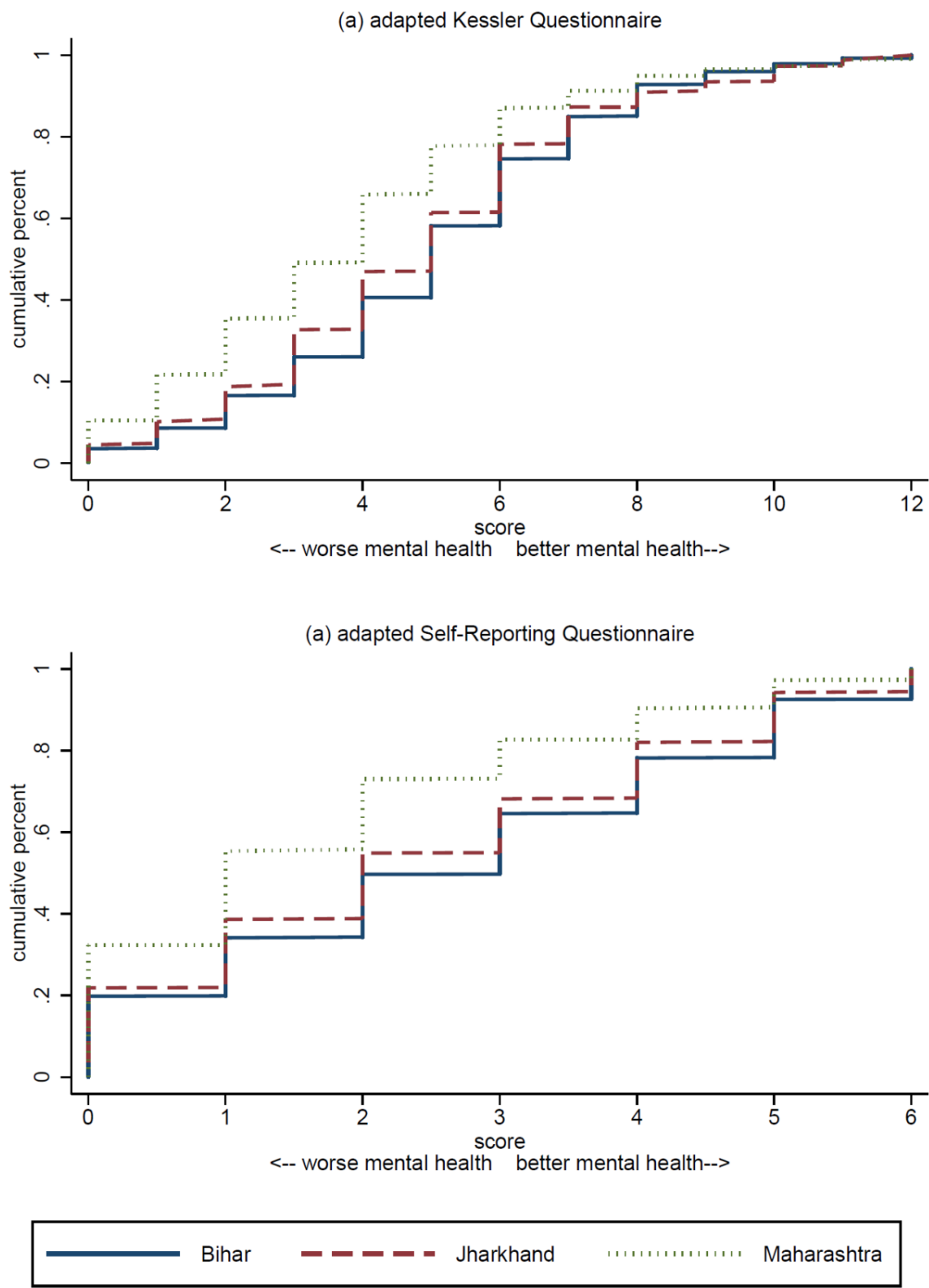
Note: Table shows coefficients as odds ratios from an ordered logistic regression. Standard errors are given in parentheses:
+ p<0.1 * p<0.05 ** p<0.01 *** p<0.001. All regressions use response weights. For models (7) and (8), data for all three states are combined, and regressions use pooled weights.

Figure 1. Proportion of respondents who report each symptom in each state



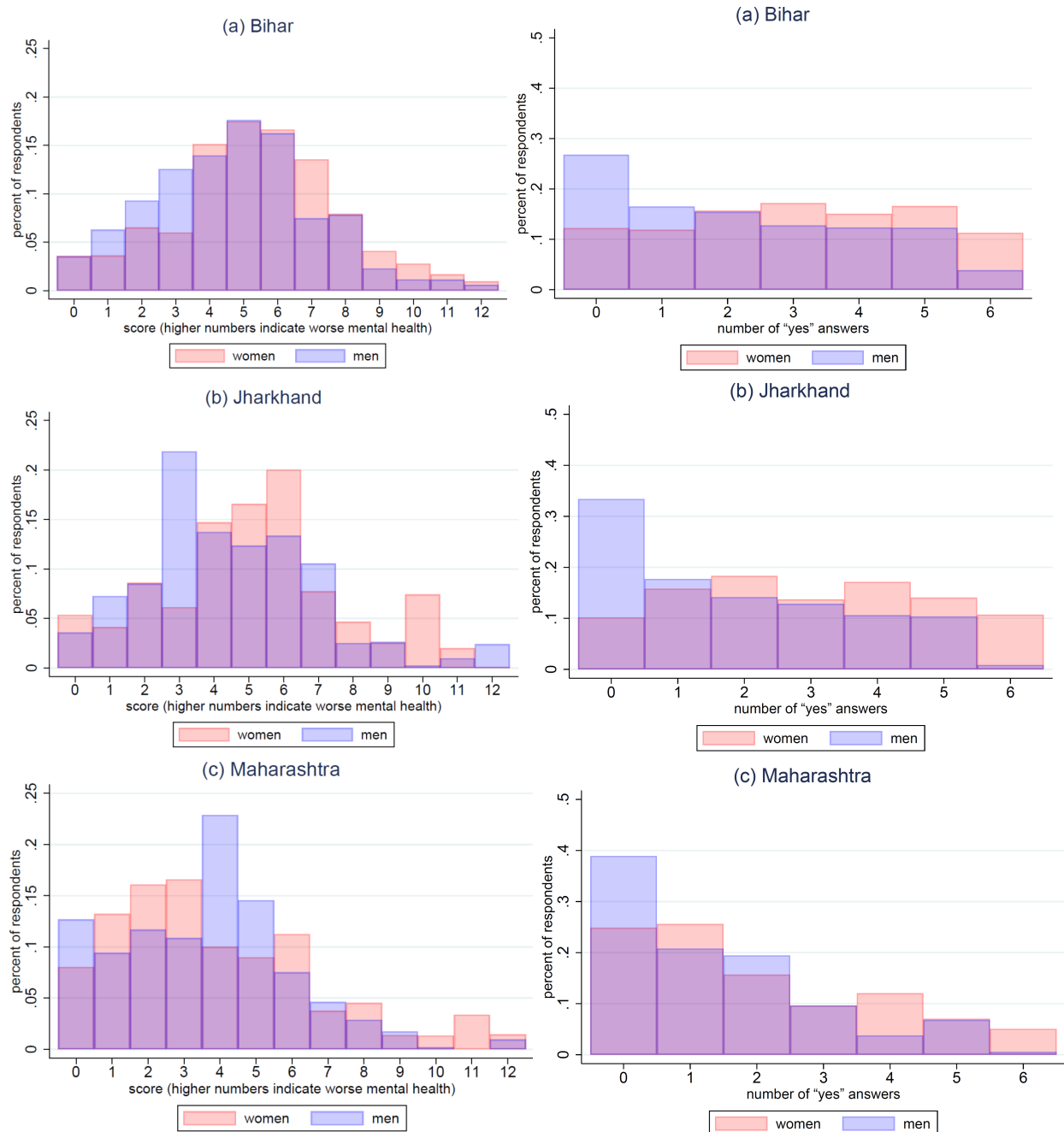
Note: The figure shows weighted proportions and 95% CIs for each symptom in each state.

Figure 2. Cumulative distributions of mental health scores, by state



Note: A description of how mental health scores are computed is given in the section on ‘Adaptations of Kessler-6 and Self-Reporting Questionnaires’. Response weights are used.

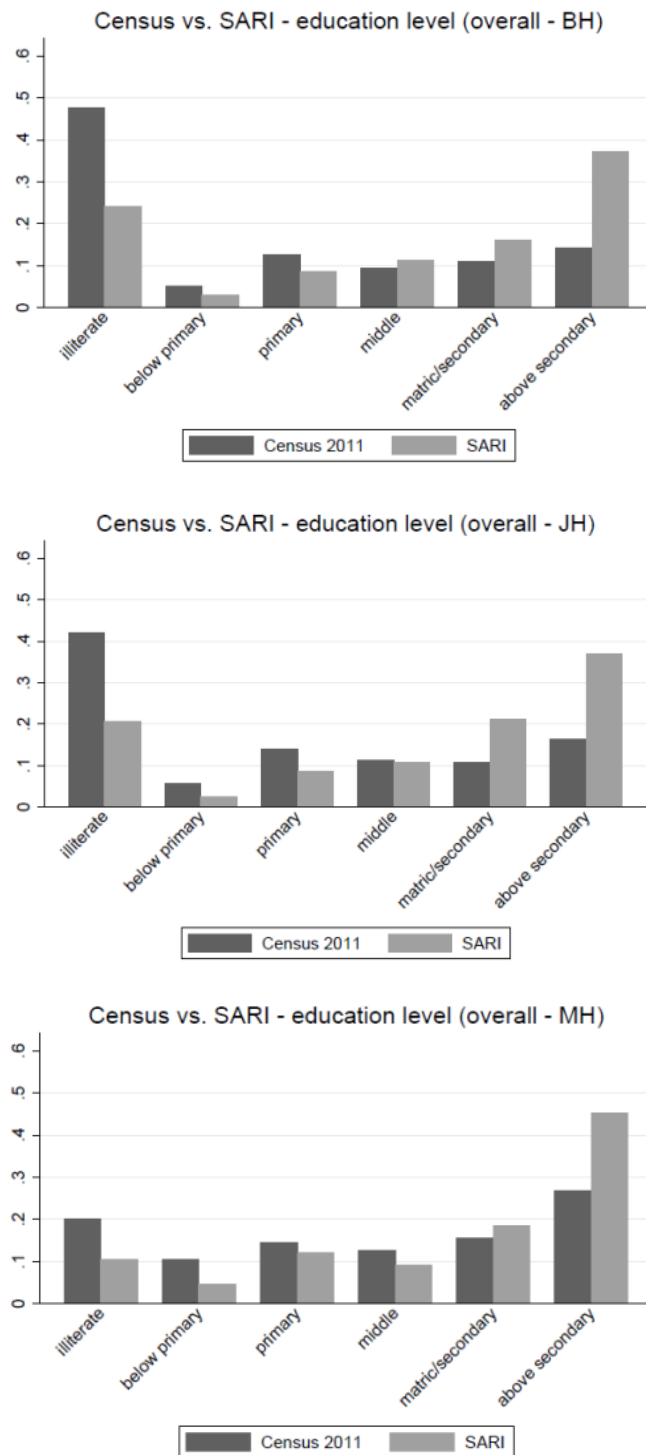
Figure 3. Distributions of mental health scores for adapted Kessler-6 (left column) and Self Reporting Questionnaires (right column), by sex



Note: Response weights are used in making the distributions

Appendix

Figure 1A. Education distributions in the Census and SARI, by state



Note: Census data (source: http://censusindia.gov.in/2011census/population_enumeration.html) are compared to unweighted SARI data to show distribution prior to applying response weights.

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