Courant Research Centre

'Poverty, Equity and Growth in Developing and Transition Countries: Statistical Methods and Empirical Analysis'

Georg-August-Universität Göttingen
(founded in 1737)

Discussion Papers

No. 273

Knowing versus Doing: Protective Health Behavior against COVID-19 in Indonesia

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June 2020

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Knowing versus Doing: Protective Health Behavior against COVID-19 in Indonesia

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Abstract

The COVID-19 pandemic shapes the lives of people around the globe – at the same time, people themselves have the power to shape the pandemic. By employing protective health behavior, such as social distancing, hygiene, mask wearing, and appropriate actions when infected, the population can contribute to alleviating the severity of an outbreak. This may be of particular importance whenever health systems or populations are vulnerable to shocks, as is frequently the case in low- and middle-income settings. Therefore, understanding the underlying drivers of protective health behavior against COVID-19 is urgently needed to shape policy responses.

We investigate the individual-level determinants of disease knowledge and behavior in the context of the COVID-19 pandemic in Aceh, Indonesia. We use data from a representative population sample of 40-70-year old's, obtained from telephone interviews between March and May 2020 and face-to-face interviews in 2019. We employ linear probability models that account for a comprehensive set of factors that were previously found to influence knowledge and practice during pandemics. These factors pertain to socioeconomic characteristics, behavioral economic preferences, pandemic knowledge, and informational sources.

We find that both knowledge and uptake of protective health behavior are relatively high. Knowledge is the largest explanatory driver of protective health behavior, while socioeconomics and economic preferences are minor determinants. However, knowledge itself is strongly shaped by socioeconomic gradients, being lower in less educated, less wealthy and rural households. Similarly, information sources predict knowledge, and differ significantly by socioeconomic groups.

Keywords: COVID-19; Health Knowledge; Health Behavior; Economic Preferences; Indonesia; South-East Asia

1. Introduction

The current pandemic induced by the novel Coronavirus disease (COVID-19) puts immense pressure on governments, health systems, and individuals worldwide. Low- and middle-income countries face additional challenges due to less resilient health and social protection systems. To contain the further spread of COVID-19 as well as its economic and health consequences, the adoption of protective health behavior is widely recommended and particularly relevant in such settings. Protective measures include preventive behaviors such as social distancing, hygiene, and mask wearing as well as appropriate actions in case of suspected infections. The success of such measures, however, relies heavily on the compliance of the population. Governments have to ensure that the population is informed on the disease and adopts the recommended behavior. Therefore, insights on how policy responses can be best aligned towards gaps in knowledge and behavior uptake are urgently needed.

In this paper, we explore the determinants of disease and prevention knowledge as well as uptake of protective behaviors in a lower-middle income setting. To shed light on these questions, we conducted a phone survey on COVID-19 with 1,113 individuals in the province of Aceh, Indonesia, between end of March and beginning of May 2020. Participants were asked about their knowledge of the pandemic, preventive actions, demand for care, perceived economic impact, and health behavior. The survey data is combined with socioeconomic information and data on economic preferences (risk preference, time preference and trust) from a baseline survey in 2019. We use linear probability models to assess the determinants of COVID-19 related knowledge and behavior.

Our main finding is that knowledge is the strongest predictor of protective action, which itself underlies a socioeconomic gradient. Overall, disease and prevention knowledge are relatively high in our sample. The main COVID-19 symptoms fever and cough are known by 73% of the sample, and 89% know at least one of the two. Droplet transmission and smear transmission are mentioned by 62% and 66% as transmission channels. Moreover, 87% respectively 77% know that social distancing and hygiene measures can prevent the spread of the COVID-19.

Disease and prevention knowledge are strongly associated with higher education, lower age and urban location. TV, internet and the community are the most important information channels for all types of knowledge, while public announcements are associated with preventive knowledge only.

Furthermore, disease and prevention knowledge are strong predictors for the uptake of preventive measures, increasing the probability of adoption by up to 87 percentage points. Socioeconomic factors influence behavior only slightly, but urban location increases adoption of preventive measures by five to seven percentage points. We find that economic preferences do not influence behavior in most cases, but more trusting individuals are four percentage points more likely to adopt social distancing, and more patient individuals are one percentage point more likely to wear masks. In contrast, economic preferences play a larger role for stated actions in the case of illness: Willingness-to-take risks and patience are positively associated with self-isolation, and patience is negatively associated with contacting health professionals.

Our study adds to the growing body of literature on COVID-19 awareness, knowledge, attitudes, and practices. First findings from online surveys in other LMICs report similarly high levels of COVID-19 awareness and symptom knowledge, albeit some studies also document wide misperceptions on the source of COVID-19 (Farhana & Mannan, 2020; Olapegba et al., 2020; Zegarra-Valdivia et al., 2020). The evidence for specific knowledge on transmission channels and prevention measures is more diverse. Droplet and smear transmission were widely known among respondents in India and Nigeria (Olapegba et al., 2020; Roy et al., 2020), while respondents in Peru knew only the latter (Zegarra-Valdivia et al., 2020). All studies report even higher knowledge levels of preventive measures than we found in our study (Olapegba et al., 2020, 2020; Roy et al., 2020; Zegarra-Valdivia et al., 2020), which might be partly explained by the different administration mode. For Indonesia, an online survey points out that even though most respondents had received basic information on COVID-19, they still report a need for more information, particularly on prevention, transmission, symptoms and testing

possibilities (Arriani et al., 2020). Finally, a global online survey showed high adherence to protective behaviors across all countries (Fetzer et al., 2020). Economic preferences might play a fundamental role in shaping the compliance to those restrictive measures. Namely, trust and patience have been positively associated with compliance, while a higher risk-seeking profile has been negatively associated to uptake (Müller & Rau, 2020)

We complement the existing evidence by using a representative sample with phone interviews. Most other COVID-19 studies use online surveys, which are likely to address younger, more educated and wealthier individuals (Boas et al., 2020). These individuals might have very different information sources as well as means to process the information and to act on it compared to the average population. Moreover, as our survey is targeted at older adults, our findings yield insights into knowledge and uptake behavior of a population group, which is of particular risk to experience a severe course of COVID-19 (Zhou et al., 2020). Furthermore, in contrast to online surveys, we were able to use unaided recall questions on knowledge and prevention, which might yield a more accurate picture on the COVID-19 awareness of the target population.

The remainder of the paper is structured as follows: First, we describe the COVID-19 situation in Indonesia and Aceh. Next, we conceptualize which factors might influence knowledge and behavior and summarize the corresponding evidence. Then, we describe our study sample and the models employed for the analysis. Finally, we present the findings and discuss the results.

2. Country background: COVID-19 in Indonesia and Aceh

During the first weeks of data collection, Indonesia had approximately 1,000 confirmed cases and COVID-19 was designated a public health emergency (see Figure 1, (Hale et al., 2020; President of Indonesia 11, 2020)). By the end of the collection period, the pandemic was declared a national disaster (President of Indonesia 12, 2020), the number of confirmed cases had tripled. Reported infection numbers in Aceh province, our study region, were still below

10, but the actual spread was expected to be higher as testing capacities are low (Serambi Indonesia, 2020b). Therefore, the data and results found in this study reflect the level of awareness, knowledge and attitudes during the early phase of the outbreak in the country.

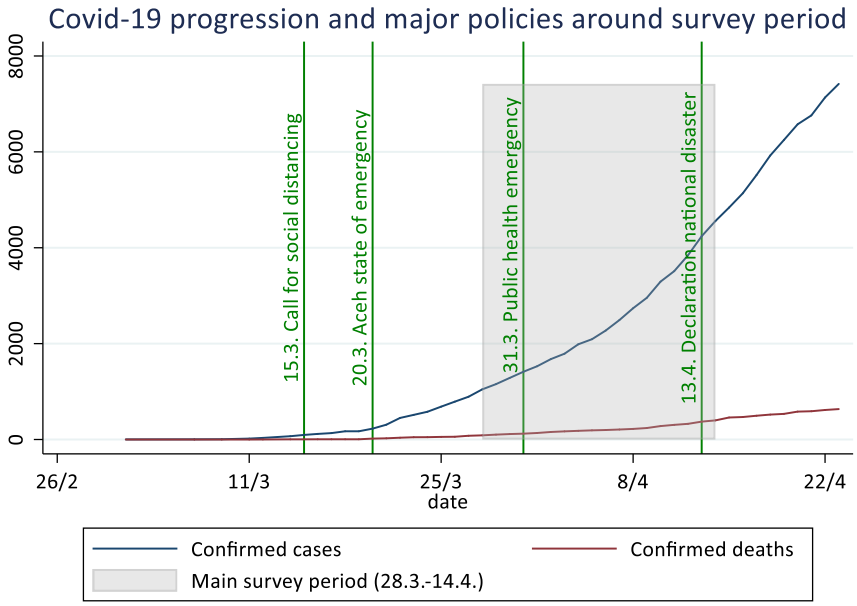

Figure 1 Cases and major policies in Indonesia. Policy dates are taken from official announcements and orders (Governor of Aceh 440/924, 2020; President of Indonesia 11, 2020; President of Indonesia 12, 2020). Cases are taken from Hale et al. (2020).

In March, the Ministry of Health launched information campaigns indicating recommended habits of prevention against the virus. The main messages were frequently washing hands with soap, cover mouth and nose when sneezing or coughing, keeping a distance to others in public, avoiding handshake and touching the face (Ministry of Health, 2020b). When having a cough, cold, and shortness of breath, the recommendation was to immediately contact a health facility (Ministry of Health, 2020a). Starting late March, the country undertook a partial lockdown, limited the daily hours of operation of airports, and dictated social distancing restrictions. (CNN Indonesia, 2020). By Mid-April, the widespread use of masks was encouraged and supported by free distributions campaigns in different regions across the country including Aceh (Serambi Indonesia, 2020a).

3. Conceptual background: determinants of knowledge and protective action

Research on the intersection of public health and economics has identified a multitude of factors that could influence health knowledge and behavior. In the following, we describe factors derived from the literature which are expected to play a role in the context of the COVID-19 pandemic: knowledge and the role of information sources as a prerequisite to practice, socio-economic characteristics, which shape both knowledge and practice, and lastly economic preferences as further mediators when translating knowledge into action.

Knowledge

One major determinant of the adoption of protective health measures is information (Dupas, 2011). In a pandemic, behavioral responses are shaped by knowledge on how the virus spreads and presents itself, which protective actions exist, how to utilize these, and which benefits they entail (Bish & Michie, 2010; Tooher et al., 2013; Yap et al., 2010). References from the H1N1 and SARS outbreaks consistently show that greater knowledge of virus symptoms and transmission channels is positively associated with precautionary actions, such as washing hands more frequently, using a mask, using hand sanitizer, and keeping distance from others (Aburto et al., 2010; Bish & Michie, 2010). In the same line, individuals with a greater knowledge of the meaning of a pandemic have been found to display stronger intentions to comply with quarantine restrictions during a hypothetical influenza outbreak (Eastwood et al., 2010).

At the same time, knowledge is itself determined by various factors. Access to information, the type of information provided and the distinct information channels used can all shape knowledge formation (Dupas, 2011; Manika & Golden, 2011). Previous pandemic outbreaks have shown that the type of information channel is associated with knowledge through levels of trustworthiness, outreach, relevance, and effective delivery (Aburto et al., 2010; Wong & Sam, 2010). In turn, the preferred information channel might vary according to sociodemographic characteristics. For example, participants of a study carried out in Malaysia

belonging to the lower education group indicated television as their preferred source of information, while internet and local community organizations were the most frequent answers among participants from the higher education group (Aburto et al., 2010; Wong & Sam, 2010). However, knowledge is likely not the only factor influencing health behavioral responses (Leung et al., 2005). The mere receptiveness to information from an individual increases the likelihood that he/she will engage in prevention behaviors (Manika & Golden, 2011). Socioeconomic characteristics as well as economic preferences and even emotionally driven factors might also determine the level of compliance with restrictive measures (Cowling et al., 2010; Müller & Rau, 2020; Wong & Sam, 2010). Furthermore, the perceived susceptibility and perceived severity of a disease can explain the willingness to adopt precautionary actions such as handwashing, mask wearing, and isolation restrictions (Bish & Michie, 2010; Lau et al., 2010).

Socioeconomic Characteristics

Factors such as age, gender, education and wealth have been found to predict knowledge and the adoption of protective action. With respect to knowledge, socioeconomic characteristics may affect the individual's access to information as well as their capacities to process it (Dupas, 2011; Mani et al., 2013). For instance, people with less education have been found to receive less information than people with higher education either because of a shortfall in information provision, health information seeking behavior or other factors (Wong & Sam, 2010). Knowledge tends to be increasing with age (Tooher et al., 2013), but the relationship is not as clear and some evidence even points towards lower knowledge in older cohorts (Lau et al., 2010).

Much of the evidence suggests higher willingness and uptake of protective measures (including hygiene, social distancing and vaccination) with increased age, but few studies also show higher uptake in younger age cohorts or no association with age (Bish & Michie, 2010). Due to age being a risk factor for a more severe disease outcome (Zhou et al., 2020), also other household members' age may potentially shape the uptake of protective measures against the coronavirus.

Studies on gender differences reveal that women have a higher likelihood of adhering to preventive behavior in the context of pandemics (Bish & Michie, 2010). Similar to knowledge, more education has been found to be positively associated with preventive behaviors during pandemics (Balkhy et al., 2010; Eastwood et al., 2010; Lau et al., 2010). The evidence on the influence of wealth is more limited, but points towards more knowledge among wealthier individuals (Tooher et al., 2013). Relatedly, how living in rural or urban areas is associated with health knowledge and protective behavior has not been exhaustively exploited in the literature. However, empirical evidence from developed countries suggests that people living in rural areas are less likely to employ protective behavior, e.g. make diagnostic tests, comply with screening guidelines, or adopt healthy habits (Bennett et al., 2008); and more likely to engage in risky health behaviors, e.g. smoking, alcohol consumption, or poor dietary management (De la Cruz-Sánchez & Aguirre-Gómez, 2014).

Economic Preferences

Beyond these factors, economic preferences and beliefs such as time preferences, risk preferences and trust can determine protective behavior. The decision to engage in preventive health measures and treatment seeking involves both a time and a risk component, which can be mediated by trust. Consequently, impatience and willingness-to-take risk are commonly expected to decrease the likelihood to invest in protective health measures[1] (Dardanoni & Wagstaff, 1990; van der Pol et al., 2017). Individuals with higher levels of trust are expected to be more likely to adopt protective health measures (Rocco et al., 2014). Moreover, to the extent that protective behavior during pandemics resembles a public good game, patient individuals are expected to be more compliant (Curry et al., 2008), while the impact of risk-preferences is more ambiguous and interlinked with trust (Bohnet & Zeckhauser, 2004).

The empirical literature supports these expected behaviors to a large extent. Patient individuals are more likely to engage in protective behavior (Goldzahl, 2017; Picone et al., 2004; Tsutsui

[1] For willingness-to-take risks, this is assuming that the protective behavior is perceived as the "safer" lottery.

et al., 2010, 2012) and to cooperate (Curry et al., 2008; Fehr & Leibbrandt, 2011). Risk-averse individuals are more likely to engage in protective behavior in some studies (Dohmen et al., 2011; Tsutsui et al., 2010, 2012) but not in all (Goldzahl, 2017; Picone et al., 2004). Moreover, trust in the information source can pose a necessary condition for uptake of protective measures (Prati et al., 2011) and might even substitute the role of knowledge in this context (Sailer et al., 2020). First findings from the COVID-19 pandemic show that patient and risk-averse individuals are more likely to avoid crowds, with patient individuals also being more likely to stay at home (Müller & Rau, 2020). Trust influences compliance with restrictions in some settings (Sailer et al., 2020), but not in all (Müller & Rau, 2020).

4. Methods

Data

We conducted interviews with 1,113 individuals from Aceh, Indonesia, as part of a larger randomized control trial on health screening uptake for non-communicable diseases. The target population of the RCT was people between 40 and 70 years of age, who are not in routine health care[2] and have access to a mobile phone in their household. This sample make-up is of particular relevance in the context of the COVID-19 outbreak, as this age cohort is also at risk for a more severe disease course if infected with the coronavirus (Zhou et al., 2020).

The sample was drawn in a two-stage stratified random design. First, we randomly drew 152 villages from a complete list of villages in the districts Aceh Besar and Banda Aceh (see Appendix Figure A 1). This draw was stratified by district to have an equal number of villages from the mostly rural Aceh Besar and the mostly urban provincial capital Banda Aceh. Within villages, households were selected randomly and if more than one household member met the inclusion criteria, one was selected randomly.

[2] Exact inclusion criteria: no previous diabetes or hypertension diagnosis, no diabetes screening during the previous year and not in regular care for another disease at the time of the baseline interview

This study draws on information collected during face-to-face interviews in November and December 2019 and a follow-up telephone survey in 2020 conducted between March 28th and May 2nd. 90% of the interviews were completed before April 14th (see appendix A.1 for the calling procedure). During the baseline survey, we collected information on socioeconomic characteristics, household member characteristics, and economic preferences. We measured wealth using an asset index according to the procedure of the demographic and health survey (The DHS Program, n.d.)[3]. We measured economic preferences on risk and patience with self-reported survey questions detailing a ten-point Likert-scale, taken from and validated by the Global Preferences Survey (Falk et al., 2016, 2018). Trust was measured with a self-reported survey question ("In general, one can trust people") on a four-point agreement scale as used in the German Socioeconomic Panel (Kantar Public, 2018).

Questions on COVID-19 knowledge and behavior were adapted from studies on the 2009 H1N1 pandemic (Balkhy et al., 2010; Ibuka et al., 2010) and collected during the telephone interviews. Knowledge of transmission, symptoms, and prevention as well as uptake of protective behavior were measured by unaided recall questions, in order to minimize response bias and misreporting. The perceived likelihood of contracting the coronavirus was measured with a four-point Likert scale ranging from very likely to very unlikely. Perceived severity of COVID-19 was measured by ranking the perceived danger of this virus against that of tuberculosis and diarrhea, which are the two infectious diseases that cause most deaths in Indonesia (IHME, 2020).

Outcome definitions

Our outcomes of interest are disease and prevention knowledge and protective behavior. We analyze disease knowledge based on knowing about the main transmission channels and symptoms of COVID-19. By the time of our survey, the transmission through droplets was

[3] The components consist of 10 assets that were found to be most influential when determining the same asset index in the Indonesian National Socioeconomic Survey 2017 (SUSENAS) for the two sample districts: ownership of a gas cylinder, refrigerator, PC, TV, jewelry, AC, car, improved latrine, motorbike and improved drinking water.

already confirmed, while the evidence on smear transmission was less conclusive. We measure knowledge on droplet transmission with a binary variable indicating if the respondent stated that the virus can be transmitted through droplets after coughing or sneezing. A binary variable for knowledge on smear transmission indicates whether the respondent stated that the virus can be contracted by touching an infected person (e.g. shaking hands) or touching objects used by an infected person.

Officially stated symptoms of COVID-19 changed over the course of the disease. Before our survey started, sneezing and having a cold were also mentioned as symptoms by the WHO and the Indonesian Health Ministry. However, as these were dropped from the symptom list during our survey, we focus our analysis on cough and fever, which were recognized symptoms throughout the survey period. We define symptom knowledge as mentioning both, fever and cough, as COVID-19 symptoms.

We focus our analysis on three most prominent preventive measures: Social distancing, hygiene, and mask wearing. We define social distancing as at least one mentioned measure out of avoiding group gatherings, avoiding close contact to others and staying at home. Hygiene is defined as frequently washing hands or using hand sanitizer, clean and disinfect often, and/or cover with forearm or tissue when sneezing.

Finally, we are interested in planned actions in the case a respondent suspects being infected with the coronavirus. We classify possible actions into two categories: Isolation, if respondents plan to stay at home or to quarantine, and contacting a doctor, if respondents plan to call or contact health professionals.

Statistical Analysis

We analyze the determinants of protective health behavior and of pandemic knowledge using two types of linear probability regression specifications each.

Determinants of Knowledge

First, we estimate the determinants of knowledge using a base specification of only socioeconomic regressors:

$$y_i = AGE_i + FEMALE_i + EDUCATION_i + WEALTH_i + URBAN_i + \varepsilon_i \quad (1)$$

where y_i is a vector of dummy outcome variables indicating whether the respondent knew the pandemic knowledge in the dimensions of disease transmission (droplets, smear), symptoms, and preventive measures (social distancing, hygiene, mask wearing).

AGE_i is a dummy for whether the respondent is over 50; $FEMALE_i$ is a dummy for being female; $EDUCATION_i$ is a categorial variable specifying no or primary education, lower secondary education, or higher secondary or more education; $WEALTH_i$ is a dummy for having an asset index above the median; $URBAN_i$ is a dummy variable for living in the city of Banda Aceh; and ε_i, the error term.

In a second specification, we are further examining the role of information channels in knowledge formation:

$$y_i = AGE_i + FEMALE_i + EDUCATION_i + WEALTH_i + URBAN_i + INFORMATION\ CHANNEL_i + \varepsilon_i \quad (2)$$

where the outcome y_i, as well as the socioeconomic characteristics are defined as in equation 1). $INFORMATION\ CHANNEL_i$ is a vector of dummy variables specifying having received COVID-19 knowledge through TV, newspaper, internet or social media, radio, public announcements, and the family or community.

Determinants of Uptake

Next, we model the determinants of protective health behavior using a base specification of only socioeconomic regressors:

$$y_i = AGE_i + AGE\_HH_i + FEMALE_i + EDUCATION_i + WEALTH_i + URBAN_i + \varepsilon_i \quad (3)$$

where y_i is an outcome vector of dummy variables indicating whether the respondent adopted preventive measures (social distancing, hygiene, wearing masks) and actions in case of illness (isolation, contacting a doctor). The socioeconomic characteristics are defined as in equation 1). We additionally include the dummy variable AGE_HH_i which

indicates whether the respondent's household includes other members over 50 years of age. As own health behavior also influences the disease risk of other family members, we use this as a proxy for households more likely to experience a severe course of the disease.

In a second specification, we are further examining the role of pandemic knowledge and economic preferences in the adoption of protective health behavior:

$$y_i = AGE_i + AGE\_HH_i + FEMALE_i + EDUCATION_i + WEALTH_i + URBAN_i + TRANSMISSION_i + SYMPTOMS_i + PREVENTION_i + ECON\ PREFERENCES_i + \varepsilon_i \quad (4)$$

where the outcome y_i, as well as the socioeconomic characteristics are defined as in equation 3). $TRANSMISSION_i$ are binary variables for knowledge on droplet and smear transmission. $PREVENTION_i$ is a set of dummy covariates specifying whether the respondent knows the specified preventive measures (social distancing, hygiene, wearing maks). $SYMPTOMS_i$ is dummy variable indicating knowledge on fever and cough as symptoms of the coronavirus (like in the outcome definition); $ECON\ PREFERENCES_i$ is a set of covariates specifying the willingness to take risks, patience, and trust.

In the regressions of the determinants of preventive actions, the relevant and corresponding transmission and prevention knowledge covariates are included as regressors. More specifically, we assume that knowledge on smear and droplet transmission matters for social distancing, but for hygiene the relevant driver is knowledge on smear transmission, while for wearing masks it is droplet transmission. In the regressions of determinants of actions in case of illness (isolation and contacting a doctor), knowledge of the main symptoms is included as a regressor as this is a prerequisite for detecting a potential infection.

5. Results

Descriptive statistics

We were able to re-interview 70% of our baseline sample. Of the interviewed participants who responded to the COVID-19 module, 99% indicated to have heard of COVID-19 (item refusal: 11%), resulting in a sample of 1,113 respondents. The socioeconomic characteristics of our sample are depicted in Table 1. In our sample, 46% of the respondents are 50 years or older, and 64% are female. Moreover, 27% of the respondents have no or primary education, 22% reached lower secondary education, and 51% completed upper secondary education or higher. The sample is nearly evenly split between the city Banda Aceh and the surrounding district Aceh Besar. As depicted in Table A 1 in the appendix, our sample is statistically similar to the representative district samples from the National Socioeconomic Survey 2017 (SUSENAS), with our sample containing more women and slightly less educated individuals.

Table 1 Basic sample characteristics

	Mean	SD	N
Age	49.88	8.00	1,112
50 or older	0.46	0.50	1,112
Female	0.64	0.48	1,111
Education			
Up to Primary	0.27		299
Lower Secondary	0.22		246
Higher Secondary or more	0.51		568
Banda Aceh	0.45	0.50	501

COVID-19 is perceived as a serious threat by the large majority of respondents in our sample. Compared to two other common and severe communicable diseases in the area, diarrhea and tuberculosis, COVID-19 is ranked by nearly all respondents as the most dangerous disease (see Figure 2). Also, more than half of the respondents think it is likely they will experience COVID-19 (see Figure 2). There is an indication that the economic impacts of COVID-19 are immediate and severe. Within the first four days of our survey, when confirmed cases where still very low

in the area, 80% of the respondents reported they experienced income decreases due to COVID-19.[4]

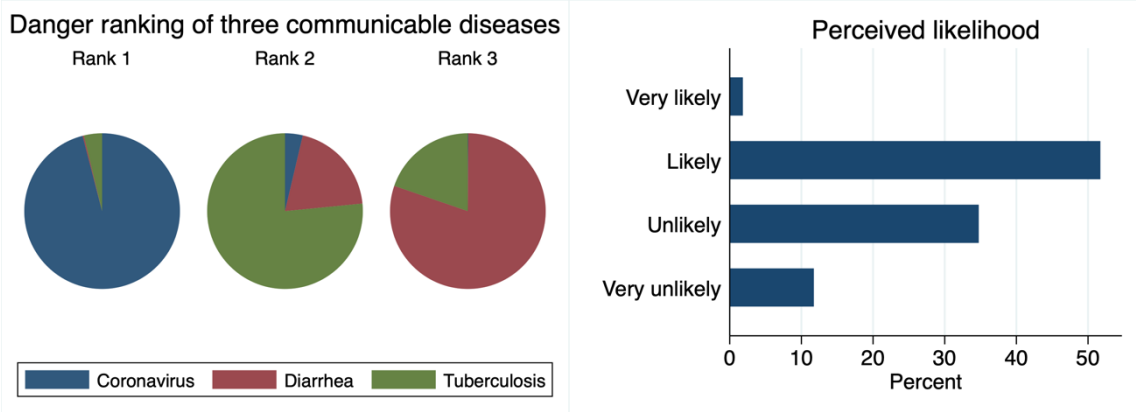

Figure 2 Perceived severity and likelihood

Most respondents could name at least one of the common symptoms of COVID-19. As depicted in Figure 3, cough and fever each are mentioned by more than 80% of the sample, followed by runny nose (39%), shortness of breath (34%), and sore throat (29%). Both, fever and cough, are named by 73% of the respondents. Two-thirds of the sample state at least one path of smear infection (touching objects used by infected persons or touching infected persons), and 62% mention that COVID-19 can be transmitted through droplets (see Figure 3). For both questions, about 8% of the sample report that they don't know the answer. Disaggregating these indicators by socioeconomic groups points towards higher knowledge in more wealthy, educated, and urban population groups (Table A 2 in the appendix).

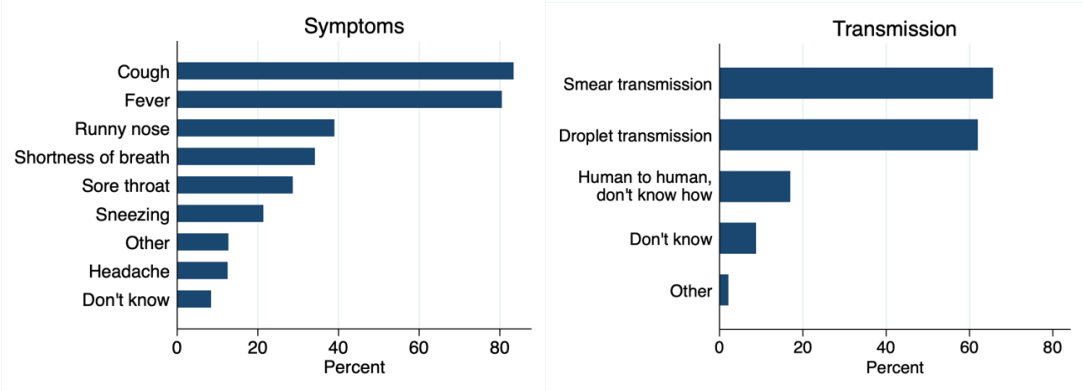

Figure 3 Knowledge on symptoms and transmission

[4] Even though the question was deemed appropriate during pre-testing, four days into the data collection, enumerators reported that this question caused distress in some respondents, who had just lost their livelihood. Hence, we excluded it immediately thereafter.

Social distancing and hygiene measures are widely known to the sample (87% and 77% respectively, Figure 4). Yet, this does not fully translate into uptake of these measures. For masks, this gap is especially sizeable: While 57% of the sample state masks can help to prevent COVID-19, only 32% report to use masks. A small proportion holds misconceptions about preventive measures. For example, some respondents believe that taking antibiotics or the use of traditional remedies could protect against the infection of the coronavirus (less than 1% in each case). In the hypothetical case of illness, 72% of the respondents would contact a doctor, and 35% would self-isolate. Table A 3 in the appendix depicts that both knowledge and practice are on average higher in the group with higher education and those living in urban areas, whereas other socioeconomic groups show less clear patterns than for disease knowledge.

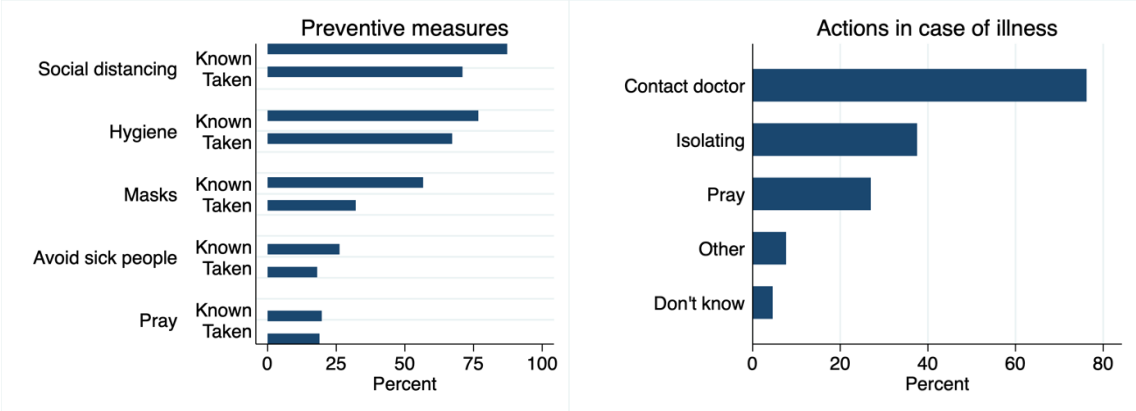

Figure 4 Knowledge and behavior regarding protective measures.

As depicted in Figure 5, most respondents received their COVID-19 information from the TV and the family or community. Internet and social media were used significantly more by respondents younger than 50 and those with a higher secondary education or more (Table A 4). Older and less educated individuals use to a lesser extent the TV for information, but to a significantly larger extent the family and the community, compared to younger and higher educated respondents.

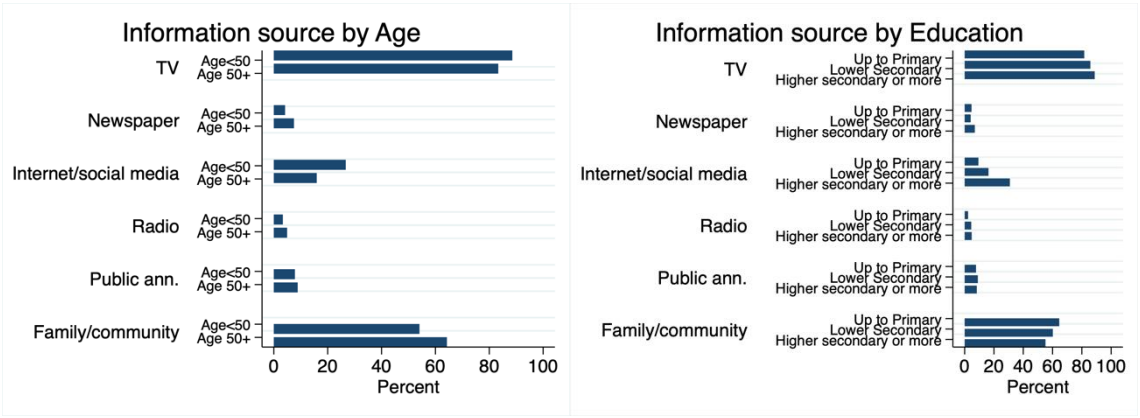

Figure 5 Information sources by group

Determinants of knowledge

The results of estimating equations 1 and 2 on the disease knowledge outcomes can be found in Table 2. We find that belonging to the group of respondents aged 50 years or older is significantly associated with less knowledge of transmission via droplets. We also find an education gradient that is consistent for all specifications and knowledge categories. Having a higher education is associated with a 7.8 percentage points (p.p.) increase in the probability of knowing droplets to be a transmission channel, an 8.2 p.p. increase of knowing about smear transmission, and a 10 p.p. increase in knowledge of the two most common symptoms.

Wealth is significantly and positively associated with smear transmission knowledge in both specifications as well as with droplet transmission knowledge in the base specification. Living in urban areas is positively associated with knowledge levels, from a 5.2 p.p. increase in the probability of knowing smear transmission channel to a 16.9 p.p. increase in the probability of droplet transmission knowledge, both according to the base specification. Among the sources of information, TV, internet and/or social media, and family and community are significantly and positively associated with the three measures of knowledge, while radio seems to play a role only for smear transmission knowledge. The magnitudes of all coefficients are decreasing when the information channels are considered in the model. This change is significant for age and gender in the case of droplet transmission, for higher education and wealth in the case of both types of transmission knowledge, and for location in all specifications (see Table A 5 in the appendix).

Table 2 Estimation results on disease knowledge

	(1) Droplet transmission	(2) Droplet transmission	(3) Smear transmission	(4) Smear transmission	(5) Fever and cough	(6) Fever and cough
50 or older	-0.129***	-0.106***	-0.031	-0.028	-0.040	-0.034
	(0.029)	(0.028)	(0.029)	(0.029)	(0.027)	(0.027)
Female	-0.044	-0.021	-0.054*	-0.045	0.001	0.008
	(0.030)	(0.029)	(0.029)	(0.030)	(0.028)	(0.027)
Lower Secondary	0.017	0.009	-0.008	-0.016	0.040	0.034
	(0.041)	(0.040)	(0.041)	(0.040)	(0.039)	(0.037)
Secondary and above	0.111***	0.078**	0.102***	0.082**	0.112***	0.100***
	(0.036)	(0.035)	(0.036)	(0.036)	(0.034)	(0.033)
Wealth above median	0.059**	0.037	0.127***	0.116***	0.018	0.006
	(0.029)	(0.028)	(0.029)	(0.029)	(0.027)	(0.027)
Urban	0.169***	0.135***	0.052*	0.032	0.084***	0.066**
	(0.030)	(0.029)	(0.029)	(0.029)	(0.028)	(0.027)
TV		0.276***		0.170***		0.270***
		(0.041)		(0.042)		(0.038)
Newspaper		0.064		0.030		-0.014
		(0.060)		(0.061)		(0.057)
Internet/social media		0.236***		0.129***		0.091***
		(0.035)		(0.036)		(0.033)
Radio		-0.076		0.187***		0.071
		(0.070)		(0.071)		(0.065)
Public announcements		0.057		0.018		0.033
		(0.050)		(0.051)		(0.047)
Family/community		0.149***		0.140***		0.164***
		(0.029)		(0.029)		(0.027)
Obs.	1096	1096	1096	1096	1095	1095
Mean	0.620	0.620	0.656	0.656	0.734	0.734
R2	0.076	0.153	0.046	0.088	0.031	0.102

Determinants of disease knowledge. Droplet transmission indicates whether the respondent states that COVID-19 might be transmitted through droplets. Smear transmission indicates whether the respondent names touching infected persons or objects used by infected persons as transmission channels. Fever and cough indicates whether the respondent names fever and cough as symptoms for a COVID-19 infection. Education is grouped into no education or primary school, lower secondary school, and higher secondary school or higher. Wealth above median indicates whether the household asset index lies above the median, stratified by urban and rural area. Urban indicates living in the city of Banda Aceh. TV, newspaper, internet/social media, radio, public announcements, family/community are binary variables indicating from which information sources COVID-19 knowledge was obtained (multiple answers possible). Standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3 portrays the determinants of disease prevention knowledge. Namely, we evaluate the drivers of social distancing, hygiene, and mask-wearing knowledge. The education gradient for higher secondary school or higher remains consistent for all specifications and also holds for lower secondary education compared to up to primary education for social distancing and mask-

wearing. Living in urban areas is positively associated with hygiene and masks wearing knowledge. Again, the magnitude of the coefficients decreases slightly when information sources are taken into account (for statistical significance of these changes, see Table A 5 in the appendix).

Table 3 Determinants of disease prevention knowledge

	(1) Social dist.	(2) Social dist.	(3) Hygiene	(4) Hygiene	(5) Wear masks	(6) Wear masks
50 or older	-0.024	-0.026	-0.021	-0.010	-0.050*	-0.046
	(0.021)	(0.021)	(0.026)	(0.025)	(0.030)	(0.029)
Female	0.014	0.024	0.041	0.053**	0.002	0.025
	(0.021)	(0.021)	(0.026)	(0.026)	(0.031)	(0.030)
Lower Secondary	0.053*	0.050*	0.054	0.048	0.077*	0.068*
	(0.029)	(0.029)	(0.037)	(0.035)	(0.043)	(0.041)
Secondary and above	0.079***	0.071***	0.130***	0.111***	0.113***	0.091**
	(0.026)	(0.026)	(0.032)	(0.032)	(0.038)	(0.037)
Wealth above median	0.001	-0.006	0.040	0.027	0.136***	0.120***
	(0.021)	(0.021)	(0.026)	(0.025)	(0.031)	(0.029)
Urban	0.013	0.004	0.069***	0.049*	0.077**	0.055*
	(0.021)	(0.021)	(0.026)	(0.026)	(0.031)	(0.030)
TV		0.101***		0.237***		0.315***
		(0.030)		(0.037)		(0.042)
Newspaper		0.053		-0.011		0.088
		(0.044)		(0.054)		(0.062)
Internet/social media		0.063**		0.145***		0.127***
		(0.026)		(0.031)		(0.036)
Radio		0.030		-0.047		0.067
		(0.051)		(0.062)		(0.072)
Public announcements		0.070*		0.091**		0.142***
		(0.037)		(0.045)		(0.052)
Family/community		0.107***		0.159***		0.196***
		(0.021)		(0.026)		(0.030)
Obs.	1095	1095	1095	1095	1095	1095
Mean	0.872	0.872	0.768	0.768	0.566	0.566
R2	0.014	0.051	0.038	0.114	0.046	0.131

Determinants of preventive health knowledge. Social distancing includes staying at home, avoiding close contact with others and avoiding group gatherings. Hygiene measures include washing or disinfecting hands, sneezing or coughing in forearm or tissue and cleaning and disinfecting often. Education is grouped into no education or primary school, lower secondary school, and higher secondary school or higher. Wealth above median indicates whether the household asset index lies above the median, stratified by urban and rural area. Urban indicates living in the city of Banda Aceh. TV, newspaper, internet/social media, radio, public announcements, family/community are binary variables indicating from which information sources COVID-19 knowledge was obtained (multiple answers possible). Standard errors in parenthesis.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Wealth is associated with an increase in the probability of knowing masks-wearing as a preventive measure against COVID-19. Specifically, it is associated with a 13.6 p.p. increase for the base specification and with a 12 p.p. increase for the extended version. TV, internet/social media, and family and community remain positively and significantly associated with all measures of prevention knowledge. In addition, public announcements are positively associated with the three knowledge measures.

Determinants of protective behavior

Table 4 shows the determinants of preventive health behavior uptake, where the dependent variables are social distancing uptake, hygiene uptake, and mask-wearing uptake. Being 50 or older is associated with a 3.2 to 3.4 p.p. decrease in the probability of adopting hygiene measures, significant at the 10 percent level. Individuals living in households with above-median wealth are more likely to wear masks, whereas having a household member that belongs to the older cohort is negatively associated. Living in urban areas is positively associated with adopting the three distinct behavior measures and remains significant at the 1 (and 5) percent level for social distancing and wearing masks (and hygiene).

Specific knowledge of the preventive measure is associated with a higher probability of adoption of the preventive practices. Social distancing knowledge is associated with a 74 p.p. increase in the probability of social distancing uptake, hygiene knowledge is associated with a 86.6 p.p. increase in the probability of adopting hygiene behavior, and knowledge on wearing masks is associated with 53.3 p.p. increase in the probability of wearing masks. Lastly, the probability of wearing masks is positively associated with patience whereas the probability of complying with social distancing recommendations is positively associated with trust.

Table 4 Determinants of preventive behavior

	(1) Social dist.	(2) Social dist.	(3) Hygiene	(4) Hygiene	(5) Wears masks	(6) Wears masks
50 or older	-0.015	-0.015	-0.034*	-0.032*	-0.010	-0.011
	(0.024)	(0.024)	(0.019)	(0.019)	(0.024)	(0.024)
Other member 50+	0.015	0.014	0.012	0.011	-0.056**	-0.054**
	(0.024)	(0.024)	(0.019)	(0.019)	(0.024)	(0.024)
Female	-0.009	-0.004	-0.013	-0.014	0.039	0.040
	(0.025)	(0.025)	(0.019)	(0.020)	(0.024)	(0.025)
Lower Secondary	-0.034	-0.035	-0.029	-0.027	0.018	0.015
	(0.033)	(0.033)	(0.026)	(0.026)	(0.033)	(0.033)
Higher secondary or more	0.013	0.013	-0.018	-0.019	0.037	0.037
	(0.029)	(0.029)	(0.023)	(0.023)	(0.029)	(0.029)
Wealth above median	0.006	0.007	-0.007	-0.005	0.060**	0.054**
	(0.024)	(0.024)	(0.019)	(0.019)	(0.024)	(0.024)
Urban	0.064***	0.070***	0.045**	0.046**	0.074***	0.073***
	(0.024)	(0.024)	(0.019)	(0.019)	(0.024)	(0.024)
Droplet transmission	0.034	0.030			0.036	0.039
	(0.025)	(0.025)			(0.025)	(0.025)
Smear transmission	0.057**	0.056**	-0.001	0.001		
	(0.025)	(0.025)	(0.020)	(0.020)		
Social dist.	0.737***	0.740***				
	(0.036)	(0.036)				
Hygiene			0.867***	0.866***		
			(0.022)	(0.023)		
Wear masks					0.534***	0.533***
					(0.024)	(0.024)
Risk taking		0.008		0.002		-0.004
		(0.005)		(0.004)		(0.005)
Patience		-0.004		-0.003		0.009*
		(0.005)		(0.004)		(0.005)
Trust		0.039**		-0.021		-0.001
		(0.020)		(0.016)		(0.020)
Obs.	1077	1077	1077	1077	1077	1077
Mean	0.713	0.713	0.676	0.676	0.322	0.322
R2	0.338	0.342	0.614	0.615	0.380	0.382

Determinants of preventive health behavior. Social distancing includes staying at home, avoiding close contact with others and avoiding group gatherings. Hygiene measures include washing or disinfecting hands, sneezing or coughing in forearm or tissue and cleaning and disinfecting often. Education is grouped into no education or primary school, lower secondary school, and higher secondary school or higher. Wealth above median indicates whether the household asset index lies above the median, stratified by urban and rural area. Urban indicates living in the city of Banda Aceh. Willingness-to-take-risk and patience are elicited on a scale from 0 to 10 using the module from the Global Preference Survey. Trust is measured as general trust in people using a four-point Likert scale. Standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Finally, Table 5 displays the estimation results for actions in case of a suspected COVID-19 infection. Respondents aged 50 or older in our sample are 7.2 to 7.5 p.p. less likely to isolate in case of contracting the novel Coronavirus whereas having a family member in the household aged 50 or older is positively associated with contacting a doctor in case of illness. People with wealth above the median are more likely to contact a doctor if they suspect they have the disease.

Table 5 Determinants of action in case of a suspected infection

	(1) Isolating	(2) Isolating	(3) Contact doctor	(4) Contact doctor
50 or older	-0.075**	-0.072**	0.029	0.033
	(0.029)	(0.029)	(0.027)	(0.027)
Other member 50+	0.047	0.049	0.075***	0.073***
	(0.030)	(0.030)	(0.028)	(0.028)
Female	-0.049	-0.035	-0.040	-0.042
	(0.031)	(0.031)	(0.028)	(0.028)
Lower Secondary	-0.035	-0.040	0.049	0.055
	(0.042)	(0.041)	(0.038)	(0.038)
Higher secondary or more	0.017	0.015	0.048	0.047
	(0.037)	(0.036)	(0.034)	(0.034)
Wealth above median	0.004	-0.009	0.070**	0.078***
	(0.030)	(0.030)	(0.028)	(0.028)
Urban	0.130***	0.147***	-0.069**	-0.064**
	(0.030)	(0.030)	(0.028)	(0.028)
Fever and cough	0.181***	0.191***	0.179***	0.180***
	(0.033)	(0.033)	(0.030)	(0.030)
Risk taking		0.014**		0.008
		(0.006)		(0.006)
Patience		0.013**		-0.013**
		(0.006)		(0.005)
Trust		0.005		-0.029
		(0.025)		(0.023)
Obs.	1083	1083	1083	1083
Mean	0.359	0.359	0.735	0.735
R2	0.064	0.081	0.056	0.062

Determinants of action in case of illness. Isolating includes quarantining or staying at home in case of illness. Contact doctor includes calling health professionals or visiting health facilities. Education is grouped into no education or primary school, lower secondary school, and higher secondary school or higher. Wealth above median indicates whether the household asset index lies above the median, stratified by urban and rural area. Urban indicates living in the city of Banda Aceh. Fever and cough indicates whether the respondent names fever and cough as symptoms for a COVID-19 infection. Willingness-to-take-risk and patience are elicited on a scale from 0 to 10 using the module from the Global Preference Survey. Trust is measured as general trust in people using a four-point Likert scale. Standard errors in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

People living in urban areas have a higher likelihood of isolating in case of illness, but a lower likelihood of contacting a doctor. Specific knowledge of COVID-19 symptoms is positively associated with isolating and contacting a doctor in case of illness. Lastly, willingness to take risks is positively associated with isolation whereas patience is positively associated with isolating but negatively associated with contacting a doctor. Trust is not found to be a significant driver for action.

6. Discussion

The aforementioned results show several important determinants of pandemic knowledge and protective health behavior. Even though the COVID-19 outbreak was, according to official records, not yet advanced in Aceh at the time of the survey, awareness of and knowledge on the coronavirus was already very high. Almost all respondents were aware of the coronavirus and the majority was able to name correct transmission channels, symptoms, and preventive mechanisms. Namely, over three-quarters of the sample knew that fever and cough are symptoms of the coronavirus and that social distancing and hygiene are preventive measures against it. In comparison, transmission channels were less well known, but can still be named by a majority of respondents. While findings from other literature vary substantially across settings, our sample respondents' knowledge on transmission channels appears to be comparable to several studies on the H1N1 pandemic and to be generally higher for preventive mechanisms (Tooher et al., 2013). Preliminary findings on the COVID-19 pandemic show that also in other geographical regions prevention knowledge was very high, while evidence on transmission modes and symptoms was more varied (Olapegba et al., 2020; Roy et al., 2020; Zegarra-Valdivia et al., 2020).

We find that knowledge underlies strong socioeconomic gradients. Younger age, higher education, higher wealth, and living in urban areas are all associated with significantly higher knowledge across several outcomes. These findings are consistent with a large body of evidence, showing that old age, higher education, and employment is associated with higher

knowledge on the H1N1 pandemic (Lau et al., 2010; Tooher et al., 2013). The socioeconomic gradients may be explained if population groups of lower socioeconomic backgrounds face challenges in accessing information and/or in the understanding of the information provided (Dupas, 2011; Mani et al., 2013). In order to understand these mechanisms better, we examine where respondents receive their information from. We find TV to be the most commonly utilized source, followed by family and community, and to a lower extent also the internet and social media. Importantly, our descriptive analyses reveal that those with a lower socioeconomic background tend to rely relatively more often on social networks, such as family and community, whereas higher socioeconomic backgrounds utilize the internet to a greater extent. Evidence on COVID-19 is still focused on online surveys, which by design find a substantially higher share of internet usage (Arriani et al., 2020), literature from previous pandemics show similar patterns to our results (Wong & Sam, 2010). Our regression analysis shows that all of these channels are positively associated with higher knowledge, family and community – the channel most used by less educated respondents – does so to a significantly lower degree in a number of outcomes (see Table A 5 in the appendix). One potential indication for different channels conveying different contents is that public announcements are only significantly related with the knowledge of preventive health behaviors, but not with more general knowledge on transmission channels or symptoms. In the context of COVID-19, it has been common for public announcements, typically conducted via speakers on cars or mosques, to provide listeners with advice on how to protect oneself against the virus. While our analysis does not lend itself to disentangle the underlying pathways through which socioeconomic characteristics influence knowledge, our overall results do suggest that different population groups access information via different channels.

When examining the determinants of preventive health behaviors, several findings are noteworthy. First of all, knowledge is found to be the strongest predictor of behavior adoption across all specification. Knowing of a preventive channel increases the likelihood of taking it

up by 53 p.p. in the case of wearing masks, 74 p.p. in the case of social distancing, and 87 p.p. in the case of hygiene. These are significantly higher magnitudes than those of all other associations found. More general COVID-19 knowledge, namely on the smear transmission channel, is also a significant predictor, albeit for taking up social distancing only. Interestingly, while socioeconomic characteristics are associated with knowledge formation on preventive health measures, they are seldomly significantly associated with the uptake of these. Only living in urban areas continues to be significantly associated with all behavioral responses. Wealth is now only significantly associated with wearing masks, age is only and weakly associated with the use of hygiene, and the education gradient is no longer visible at all. This finding differs from previous evidence on the uptake of preventive health behavior against pandemic diseases, where socioeconomic characteristics were frequently found to be significant predictors. However, these studies do not always include knowledge as an explanatory variable and reveal that findings were being driven by certain socioeconomic groups, such as elderly, feeling more affected by the disease (Bish & Michie, 2010). This is not the case in our sample, potentially explaining the diverging results. Finally, economic preferences are not found to be a clear driving factor in explaining behavioral adoption either. While the willingness to take risks is not associated with the adoption of any preventive measures, patience is found to be a weakly significant predictor of wearing masks. Trust has a positive and significant association with social distancing, potentially supporting the notion that social distancing can be viewed as a public good game, in which more trusting individuals are more likely to invest.

These findings suggest that concrete knowledge on how to protect oneself against the coronavirus is the main channel through which behavioral responses are determined. This is also reflected in our descriptive results, where we see that the gap between knowledge and action of a preventive mechanism does exist, but is usually rather small. From a policy perspective, this may reflect that focusing on conveying hands-on knowledge is an effective way of getting the population to adopt preventive measures. It is noteworthy that the knowledge

action gap is largest in the case of wearing masks, which is also reflected in a somewhat different pattern of regression results. One explanation might be that recommendations regarding mask wearing were less clear in the beginning of the pandemic and did not call for general adoption (Aceh Info COVID-19, 2020).

The determinants of actions in case of illness display several distinct patterns as well. Age is negatively and significantly associated with isolating. One potential reason for this may be that older respondents – a high risk group (Zhou et al., 2020) – choose to not simply stay at home, waiting to see how severe the virus presents itself. Further supporting this argument is that having another household member aged 50 years or older shows a higher probability of calling the doctor as well, while we observe only an insignificant, yet positive coefficient for own age and contacting the doctor. Furthermore, we observe a positive and significant relationship between wealth and contacting the doctor. This could potentially indicate that wealth translates into better access to the health care system. Despite far-reaching efforts to make health care access more equitable through national health insurance, these pro-rich health care access patterns have been found to prevail in Indonesia (Johar et al., 2018). Living in urban areas is positively associated with isolating, following the same pattern of increased protective behavior in the urban areas observed in the uptake of social distancing, hygiene and wearing masks. However, it is negatively and significantly associated with contacting a doctor. When applying a lower level of outcome disaggregation we find that this appears to be driven by the urban population being more likely to call a doctor, whereas the rural population is more likely to go to a doctor. There are several potential explanations for this pattern. First, there was a change in recommended behavior regarding how to contact a doctor, which may have been communicated differently in urban and rural areas (Liputan 6, 2020; Ministry of Health, 2020a). Another potential explanation could be that urbanites live closer to health care facilities, allowing them to first isolate and then visit a health care facility only on short-notice once the

disease outcome progresses – whereas people living in rural areas are not as flexible due to the greater distance to a facility.

Similar to the determinants of preventive action, knowledge is a strong predictor for these two protective actions as well. Knowing fever and cough to be symptoms of corona was associated with a 17-18 p.p. increase in the uptake of isolating and contacting a doctor – stressing again the need for knowledge-driven policy strategies. Finally, the economic preferences show a more pronounced relationship with these two types of actions than with the other preventive health behaviors. Both the willingness to take risk and patience are positively associated with isolating. Arguably, isolating can be seen as a mean to protect others rather than oneself, and might even incur personal costs, such as forgone income. Under the notion of this altruistic behavior, patient individuals could be willing to concede some of their current utility to protect others' future utility (Curry et al., 2008). The willingness to take risk might directly affect isolating by risking to incur these costs, or proxy occupational groups which can afford to stay at home (Hill et al., 2019). As the literature on pandemic behavior mainly focused on preventive health behavior and not on actions to take once feeling affected, more research needs to be done in order to better understand these patterns.

Our study underlies several limitations. First of all, while phone surveys encompass several advantages and in-person interviews are not possible during times of a pandemic, there are also potential drawbacks to be considered. For instance, it may be more difficult to re-contact respondents via phone than via home visits. We do see sample attrition from baseline to endline. However, with a response rate of 70% we compare well with the upper ranges of response rates achieved in other phone interviews (Himelein et al., 2020) and attrition is not found to be systematic. A further potential drawback of remote interviews is that respondents may be less trusting of enumerators when they speak to them on the phone than when talking to them in person. This may affect their willingness to respond or the content of their answer. In order to

minimize this, the same enumerator that had visited the respondent during the baseline survey was deployed to interview them over the phone whenever feasible.

A second limitation to be considered is that our analysis is built on self-reported measures, which may be prone to response or recall bias especially when surveying behavior. We tried to minimize the response bias as much as possible, by asking unaided questions, rather than listing answer categories for individuals. Further, the recall bias may not be as pronounced in this setting, as the pandemic-related knowledge and behavior was likely a very prominent topic for the respondents even outside of our study. Relatedly, respondents may define reported knowledge and behavior differently. For instance, while we measure whether respondents adopted regular hand washing as a protective mechanism, we do not know whether in doing so, they follow the recommended guidelines on duration and the use of soap.

Third, while we analyze a very comprehensive set of explanatory factors, we were not able to include all relevant variables identified in the literature. More specifically, evidence shows that individuals' perceptions play a role in pandemic health behavior, since beliefs on the severity of a virus, as well as how susceptible one is to contract it, will likely affect the motivation to protect oneself against it (Cowling et al., 2010; Yap et al., 2010). In our sample, the perceived severity of COVID-19 is very high for practically all respondents and therefore yields no variation. While this does not impact our analysis, it should be considered as an important contextual factor. Furthermore, perceived susceptibility of the disease is not included in the analysis due to high selective item non-response. 21% of our sample refused to answer the question on how likely they think it is that they will contract the coronavirus, a refusal rate unmatched by any other variable in our survey. This is likely due to a cultural perception, in which respondents fear this question to be self-deterministic, i.e. stating a high likelihood of contracting the coronavirus may actually cause a high likelihood. The high refusal rate in this question may therefore actually further underline the finding of a high perceived severity of the

disease in our sample. Lastly, due to the study design we are unable to show causal inferences; therefore, results should not be interpreted as such.

7. Conclusion

In this study, we examine the socioeconomic, behavioral economic, and informational determinants of protective health behavior against the coronavirus in Aceh, Indonesia. Our study was carried out via home visits and phone interviews, allowing for a more complete and representative population segment than the frequently used online studies on pandemic behavior. We identify several important determinants of pandemic knowledge and protective health actions, allowing for a guided policy response. We find knowledge to be the driving factor in protective behavioral responses against the coronavirus. Knowledge itself is underlying several socioeconomic patterns, which need to be taken into consideration for equitable policy strategies.

More research needs to be carried out in order to better understand and alleviate the underlying mechanisms of the socioeconomic gradient in knowledge formation. Particularly, the strong and consistent rural-urban gap both in knowledge and uptake needs to be further explored. Lastly, even though curative health behavior is likely to be driven by health system factors, we show individual-level determinants to matter as well in our analysis on actions in case of illness. However, most literature focuses only on preventive health behavior. As the COVID-19 outbreak progresses and more individuals will be faced with such a scenario, more evidence is urgently needed in order to develop effective population-level strategies on how to maneuver all stages of a pandemic.

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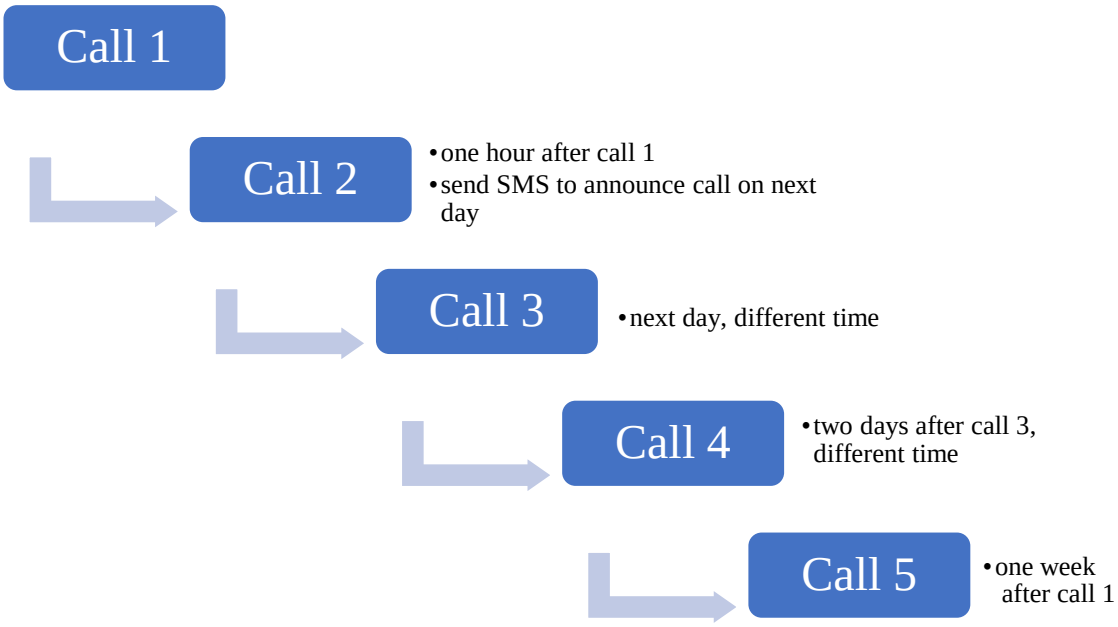
Appendix

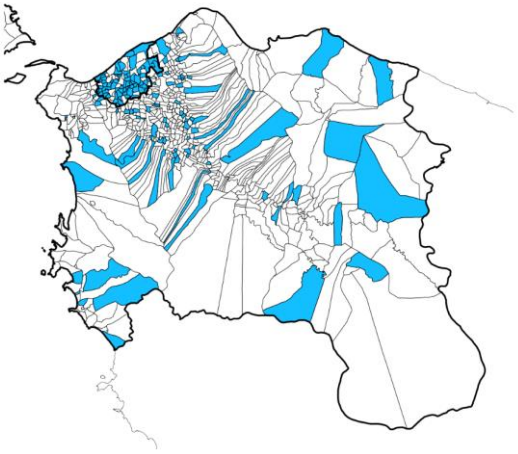
A.1. Calling procedure

The telephone interviews were scheduled according to the call pattern that is displayed below. Initially, each respondent received 5 calls, which were staggered with time delays of one hour to three days any at varying times of the day. After the second unanswered call, a standardized text message was sent announcing another call on the following day. Whenever feasible, the same enumerator that had visited the respondent during the baseline survey was deployed to call them during the phone interview, in order to maximize the response rate as well as the respondents' trust towards the enumerator. In the end of the data collection period, each number that was not answered during five calls received one additional call from another interviewer (with a different telephone number).



A.2. Figures

Figure A 1 Sampled villages with administrative boundaries



Sample villages. Boundaries of the city Banda Aceh and the district Aceh Besar are in bold

A.3. Tables

Table A 1 Differences in means of Susenas and sample characteristics

	Susenas Banda Aceh, Aceh Besar	Baseline	Corona
Age	50.5941	50.1203	49.8831
	(7.5105)	(8.1723)	(7.9951)
50 or older	0.4879	0.4656	0.4577
	(0.4999)	(0.4989)	(0.4984)
Female	0.5239	0.6379***	0.6391
	(0.4994)	(0.4807)	(0.4805)
Education			
- Up to Primary	0.2425	0.2926***	0.2686
	(0.4286)	(0.4551)	(0.4435)
- Lower secondary	0.2348	0.2164	0.2210
	(0.4239)	(0.4119)	(0.4151)
- Higher secondary or more	0.5227	0.4910	0.5103
	(0.4995)	(0.5000)	(0.5001)
Wealth above median		0.4923	0.5063
		(0.5001)	(0.5002)
Banda Aceh	0.4070	0.4372	0.4510
	(0.4913)	(0.4962)	(0.4978)
N	863	2,006	1,113

Standard deviations in parenthesis below the mean. Stars indicate significant differences from the mean listed in the previous column based on t-tests, * p<0.1 ** p<0.05 *** p<0.01; Susenas means account for sampling weights.

Table A 2 Descriptive statistics: knowledge by group

	Transmission		Symptoms
	Droplet	Smear	Fever & Cough
Total	0.62 (0.49)	0.66 (0.48)	0.72 (0.45)
Age			
- Younger than 50 (ref)	0.68 (0.47)	0.67 (0.47)	0.75 (0.43)
- 50 and older	0.55 (0.50)	0.64 (0.48)	0.69** (0.46)
Gender			
- Male (ref)	0.64 (0.48)	0.68 (0.47)	0.72 (0.45)
- Female	0.61 (0.49)	0.64 (0.48)	0.73 (0.45)
Wealth			
- Below median (ref)	0.58 (0.49)	0.58 (0.49)	0.70 (0.46)
- Above median	0.66*** (0.48)	0.73*** (0.44)	0.75* (0.44)
District			
- Banda Aceh (ref)	0.72 (0.45)	0.70 (0.46)	0.78 (0.41)
- Aceh Besar	0.53*** (0.50)	0.62*** (0.49)	0.68*** (0.47)
Education			
- Up to Primary (ref)	0.51 (0.50)	0.57 (0.50)	0.63 (0.48)
- Lower secondary	0.57 (0.50)	0.59 (0.49)	0.70* (0.46)
- Higher secondary or more	0.70*** (0.46)	0.73*** (0.44)	0.79*** (0.41)

Standard deviations in parenthesis below the mean. Stars indicate significant difference from the reference category (denoted with ref), based on ttests, * p<0.1 ** p<0.05 *** p<0.01.

Table A 3 Descriptive statistics: practices by group

	Social distancing		Hygiene		Wear mask		Action when suspect	
	Know	Do	Know	Do	Know	Do	Isolation	Contact doctor
Total	0.87	0.81	0.77	0.87	0.57	0.57	0.35	0.72
	(0.33)	(0.39)	(0.42)	(0.33)	(0.50)	(0.50)	(0.48)	(0.45)
Age								
- Younger than 50 (ref)	0.89	0.81	0.78	0.89	0.59	0.58	0.38	0.71
	(0.32)	(0.39)	(0.41)	(0.32)	(0.49)	(0.49)	(0.49)	(0.45)
- 50 and older	0.85	0.81	0.75	0.86	0.53*	0.54	0.32**	0.73
	(0.35)	(0.39)	(0.43)	(0.35)	(0.50)	(0.50)	(0.47)	(0.44)
Gender								
- Male (ref)	0.86	0.82	0.74	0.88	0.56	0.54	0.37	0.73
	(0.34)	(0.38)	(0.44)	(0.32)	(0.50)	(0.50)	(0.48)	(0.45)
- Female	0.88	0.80	0.78*	0.87	0.57	0.58	0.34	0.72
	(0.33)	(0.40)	(0.41)	(0.34)	(0.50)	(0.49)	(0.47)	(0.45)
Wealth								
- Below median (ref)	0.86	0.79	0.73	0.88	0.49	0.51	0.34	0.67
	(0.34)	(0.41)	(0.44)	(0.32)	(0.50)	(0.50)	(0.48)	(0.47)
- Above median	0.88	0.82	0.80***	0.87	0.64***	0.61**	0.36	0.77***
	(0.33)	(0.38)	(0.40)	(0.34)	(0.48)	(0.49)	(0.48)	(0.42)
District								
- Banda Aceh (ref)	0.89	0.86	0.82	0.90	0.62	0.65	0.44	0.69
	(0.32)	(0.35)	(0.39)	(0.30)	(0.49)	(0.48)	(0.50)	(0.46)
- Aceh Besar	0.86***	0.77***	0.73***	0.85**	0.52***	0.49***	0.28***	0.74*
	(0.35)	(0.42)	(0.45)	(0.36)	(0.50)	(0.50)	(0.45)	(0.44)
Education								
- Up to Primary (ref)	0.82	0.79	0.67	0.89	0.45	0.46	0.30	0.67
	(0.39)	(0.41)	(0.47)	(0.32)	(0.50)	(0.50)	(0.46)	(0.47)
- Lower secondary	0.87	0.75	0.73	0.85	0.55**	0.53	0.31	0.72
	(0.33)	(0.44)	(0.44)	(0.36)	(0.50)	(0.50)	(0.46)	(0.45)
- Higher secondary or more	0.90*	0.84*	0.83***	0.88	0.63***	0.62***	0.40***	0.74**
	(0.30)	(0.36)	(0.37)	(0.33)	(0.48)	(0.49)	(0.49)	(0.44)

Standard deviations in parenthesis below the mean. Stars indicate significant difference from the reference category (denoted with ref), based on ttests, * p<0.1 ** p<0.05 *** p<0.01.

Table A 4 Descriptive statistics: information source by group

	TV	Newspaper	Internet/ social media	Radio	Public announce–ment	Family/ community
Up to Primary (ref)	0.8161 (0.0199)	0.0468 (0.0134)	0.0936 (0.0233)	0.0234 (0.0114)	0.0769 (0.0159)	0.6455 (0.0284)
Lower Secondary	0.8577 (0.0220)	0.0407 (0.0147)	0.1626** (0.0257)	0.0447 (0.0126)	0.0894 (0.0176)	0.6016 (0.0313)
Higher secondary or more	0.8873*** (0.0145)	0.0687 (0.0097)	0.3081*** (0.0169)	0.0475* (0.0083)	0.0827 (0.0116)	0.5511*** (0.0206)
Younger than 50 (ref)	0.8856 (0.0140)	0.0415 (0.0094)	0.2670 (0.0167)	0.0332 (0.0080)	0.0779 (0.0112)	0.5406 (0.0200)
50 or older	0.8330** (0.0153)	0.0747** (0.0102)	0.1591*** (0.0182)	0.0491 (0.0087)	0.0884 (0.0122)	0.6424*** (0.0217)

Information source by group. Standard errors in parenthesis. Stars indicate statistically significant difference from the reference group (denoted with ref). * p < 0.1, ** p < 0.05, *** p < 0.01

Table A 5 P-values from testing changes in coefficients after the inclusion of information sources.

	Droplet transmission	Smear transmission	Fever and cough	Social dist.	Hygiene	Wear masks
50 or older	0.0143	0.7129	0.5475	0.7080	0.1915	0.7145
Female	0.0321	0.2856	0.4290	0.1097	0.2074	0.0411
Lower Secondary	0.5276	0.3300	0.5545	0.6305	0.5629	0.4883
Higher Secondary or more	0.0049	0.0445	0.2552	0.2606	0.0678	0.1025
Wealth above median	0.0163	0.0908	0.1180	0.1347	0.0901	0.0934
Urban	0.0003	0.0075	0.0365	0.0975	0.0119	0.0348

Table A 6 P-values from comparing coefficients of information sources.

	Droplet transmission	Smear transmission	Fever and cough	Social dist.	Hygiene	Wear masks
TV vs. Internet	0.4398	0.4329	0.0002	0.3106	0.0446	0.0004
TV vs. Family	0.0097	0.5454	0.0199	0.8640	0.0725	0.0184
Internet vs. Family	0.0340	0.7922	0.0565	0.1393	0.7045	0.1026