**IS4250**

**Community Psychological and Behavioral Responses through the First Wave of the 2009 Influenza A(H1N1) Pandemic in Hong Kong**

**Report**

By

Low Jia Wei

Liu Yue

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**Introduction**

***Research Motivation***

In the event of an influenza pandemic, there are often close to no available vaccine. The only way to prevent or slow down the spread of such a pandemic is through “non-pharmaceutical” community intervention. This intervention usually includes promotion of health and hygiene preventative measure, symptom of the pandemic disease and what to do when met with issue regarding the pandemic. Prior to this paper, there are very little data on about community psychological and behavioral responses to influenza.

In response to prior paper on Severe Acute Respiratory Syndrome (SARS), this research experiment takes into account perception of risk and anxiety which were not measured in prior SARS related paper. There have been others studies done to examine the initial response of the people in pandemic affected country. However, this paper focuses on the response of the general community in Hong Kong throughout the wave of the pandemic in 2009. It also seek to find out what factors will result in greater use of preventive measure which are the “non-pharmaceutical” community interventions.

**Methodology**

This experiment uses telephone surveys for collection of data. The surveys are designed to be cross-sectional in nature and it records information on the subjects without manipulating the study environment which in the case of this survey is the daily lives of the community in Hong Kong. The surveyors hence should not influence the subjects when conducting the survey in a way that it would change their behavior towards the pandemic of H1N1.

Cross-sectional studies are suitable for the research purpose as the research require comparison of multiple variables at the same time. This will allow them to reduce cost as addition of variables will result in very little costs hence given the amount of factors being measured, this would definitely lower the cost of the research study. Cross-sectional studies are useful to serve as a guide or springboard for future research which are similar or can a further research to test for causation.

***Methods***

This research uses phone calls to collect the results. The phone numbers are randomly selected by a random-digit dialing of all the valid land-based phone numbers which are generated by computer system using a randomization algorithm. Phone survey is used as more than 98% of the populations in Hong Kong have a valid land-based phone numbers.

Interviewers of the survey are trained to increase chance of gathering reliable and valid survey results. These phone calls were made outside of working hours to prevent the exclusion of the working groups and overrepresentations of the non-working group. The criteria of a valid survey respondent are as below:

* They must be aged 18 and above
* They must lived in the house for at least 5 days per week
* They must speak Cantonese which is to identify them as Hong Kong citizens and not foreign expats as most Hong Kong citizen speaks Cantonese amounting to 89.5% of the population [[1]](#footnote-1)
* They must give their consent to participate in the survey before the questions are asked.
* They must be available by the 5th Follow-up call if they are busy during the first 4 or else they will be deemed as an invalid survey target.

There are a total of 13 surveys being conducted throughout the research period. Participants are separated by demographics characteristics of gender and age for each survey in terms of means and proportion. Each survey took approximately 15 minutes to complete and response to the survey were ordinal Likert-type. Below shows an example of an ordinal Likert-type response:

**Do you feel those masks are important during a pandemic outbreak?**

Strongly Agree Agree Neutral Disagree Strongly Disagree

The answer to the above sample survey is ‘Agree’. Participants were asked to answer around 100 of such question in a survey. 12 out of the 13 surveys have at least 1000 respondents and with that sample size, the sampling error is at most 3%. Sampling error is usually due to differences between the sample from the population and the population itself. Randomization is used in the selection process of the research in the form of randomly generated landline number by the computer and this helps to reduce sampling error in the research. Sampling error is impossible to eliminate as it require sampling of the entire population which is expensive and definitely not feasible. The sampling error of this research is within the confidence interval which is good.

The only survey to be deemed as invalid is the one with only 504 respondents which is well below the average of about 1000. Responses from people exhibiting flu like symptoms were also excluded as they behave differently from those who do not exhibit these symptoms. Multivariable logistic regression is used for each of the survey data which give dichotomous outcome and uses more than one variable on the right side of the regression equation as opposed to linear regression which outcome is continuous and consist of one variable.

Survey number one and two psychological responses are somewhat different from the other eleven remaining surveys and the first local case did not happen until survey three. This means that the first two surveys are measuring psychological responses against a potential threat while the remaining surveys are measuring psychological responses against a confirmed or a real threat. The responses to the survey from survey 3 to 13 excluding survey 6 which have only 504 respondents were very consistent which shows that the sampling error is within a good range.

We will hence look at the results of the survey conducted and how they are being analyzed to show the impact of the study on the general population.

**Results**

Results obtained from this research do indicate correlation among the different factors that were being measured. However, it should be noted that these results do not infer causation as they are cross-sectional in nature.

The overall response rate for the survey was 69.9% which is defined as out of the number of suitable subjects who took part in the survey over the total number of suitable subjects identified.

We will first look at the overall trend before going into the multivariable logistic regression analysis part of the result. **Appendix A** shows that the State Trait Anxiety Inventory Score (STAI) of the general public remains fairly constant even at the peak number of case from September to October. There are 2 subscales within this measure of STAI. First, the State Anxiety Scale (S-Anxiety) evaluates the current state of anxiety, asking how respondents feel at that point in time and using items that measure subjective feelings of apprehension, tension, nervousness, worry, and arousal of the autonomic nervous system. The Trait Anxiety Scale (T-Anxiety) evaluates relatively stable aspects of “anxiety proneness,” including general states of calmness, confidence, and security.

**Appendix A** shows the results of perceived risk and worry. Perceived risk of infection in the following month ("absolute susceptibility") was initially high, declined in May, and temporarily rose in June as the local epidemic began, before fluctuating between 10% and 15% for the remainder of the study period. Perceived risk of infection compared to others outside your family ("relative susceptibility") remained lower throughout. Perceived severity of H INI compared with SARS ("severity") was high in the initial survey in April and decline.

**Appendix A** shows the respondents knowledge on mode of transmission. Results show that the respondents have a misconception that H1N1 is spread via cold weather and oral-feacal. It could be due to previous cases. **Appendix A** shows it is a norm for them to wash their hands using liquid soap after coming back home. The level of hygiene behavior is also very consistent throughout the pandemic period with no sudden peak or drop in proportion with the exception of disinfecting of homes which is significantly higher during earlier periods of the outbreak.

In **Appendix A,** social distancing declined as the pandemic proceed on and the only known peak is the participant avoiding crowded places during the period of end June around when the first local case was first identified.

We will now look at the multivariable logistic regression analysis result. Appendix B shows the plot replication of the results, we will explain the plot replication in more details in later part of the report as we focus on the results now. The study measures 5 factor of hygiene measure against personal variable like gender, age and educational level. It can be seen from the Table that female have higher hygiene behavior across all 5 factor that were measure.

**Contribution of Paper**

This paper has been the basis for research regarding psychological and community behavior for pandemic. It identifies the correlation between hygiene behaviors and attributes like age, gender and education level. It could be a baseline for future researcher to do a more focus to infer causation. For example, an increase of anxiety is correlated to an increase in house disinfection which is one of the preventive behaviors that was measured in the study. Hence future researcher could do a longitudinal studies on these to infer causation whether indeed anxiety leads to them disinfection there house more than usual during a pandemic outbreak.

Government in Hong Kong could use the results from this study to adjust their containment and preventive campaign to prevent the spread of this epidemic which is the only measure which could be taken during the spread of a new virus since current medication and vaccination does not work on new strains of virus. Government can see the difference between their recommended measure and how the general public really reacts to the pandemic. They can then adjust their recommended measure on how to educate the general public whether be it through a period of time or through some incentive. This study shows that the general public does not have significant behavioral change despite government effort to improve hygiene and preventive behavior.

The study also reported that males have poorer hygiene and preventive behavior than female hence government could make use of this information to develop different measure targeting the different demographics as identified by the study which is gender, age or education level. This will allow them to formulate measure to target smaller section of the popular for more effective counter-measure against the pandemic outbreak to mitigate the impact of it on the economical and social stability of the country.

This paper have been cited by a total of 71 research paper according to **Appendix E**. Majority of the paper that cite it are related to influenza and H1N1 related with some on psychological behavior not relating to influenza or H1N1. It can be noted that some of the paper are research conducted outside of Hong Kong and Asia Pacific which might have different influential and external factor. They are countries like Norway and Czech Republic in Europe.

**Challenges & Limitation**

***Limitations***

As with many researches, there will be challenges faced while performing the experiment and also limitation of the methodology and resulted gathered.

The first limitation is that due to the cross-sectional nature of the survey conducted, we cannot infer any causation from any of the analysis done. This means that the correlation mentioned in the result does not means causation. For example, males having poor hygiene and protective behavior does not means that being male caused them to have such a behavior.

Factors associated with the results could suffer from reverse causation. Reverse causation means that the outcome caused the initial exposure instead of the other way else. In the case of greater hand hygiene leading to lower anxiety could very well mean that lower anxiety lead to greater hand hygiene.

Biasness will always be present in any surveys. In the case of this experiment, selection bias could be potentially found in the case of exclusion of the working class. Additionally, there is no data from non-respondent hence we cannot be truly sure of extend of the selection bias.

Although, telephone interview have been accepted as methodology for this type of study on preventive behavior during pandemic; limitation still exists. It suffers from recall and social conformity bias which may affect the result as the response they gave might not be what they really did in the real situation. This may affect the accuracy of the survey results when what they recall is different from what they actually did or when they choose to reply the standard answer which they think other will most likely answer.

There is also difficulty in checking validity of the information supplied by the respondent to match to the requirement as it is over the phone and the person might not provide the true information. This is shown in the huge of number of invalid responses which is nearly about 90% of the total number of landline dialed.

This study is conducted in Hong Kong and hence might not be applicable to pandemic in other region for instant the spread of Ebola in Saudi Arabia. These two countries could have very little similarities between community behavior and psychological response to a pandemic since their standards and way of living is very much different from each other. Hence, this study might not be able to be a strong base for studies of pandemic in very different region. However, it could be used for similar area in the same region such as Taiwan or South East Asian countries. There should be some similarities between them which could prove useful to support and become the basis of research in countries like Saudi Arabia as this paper have been cited by country outside of the Asia Pacific as mentioned in the contribution of the paper.

***Challenges***

The main challenge for this research experiment is that it is hard to infer causation from the results collected by this methodology of a cross-sectional survey. They will need to conduct longitudinal studies instead of the cross-sectional studies which will require long period of time. This will require more resources to conduct longitudinal studies hence resulting in a much more expensive study. There will also be a chance that research subject might drop out half way due to the long duration of such studies hence reducing the sample size and data point which can be obtained. If this experiment is conducted as a longitudinal study, they will need to monitor over 10,000 study subjects over a period of time and constantly gather input from them instead of the current one time off survey. Hence, it is not that feasible given the large amount of sample and limited resources of the research. It would be best to set up the foundation in this paper and let it be a reference for future research since some correlation can be spotted which can be further developed into a more focus longitudinal studies to infer causation.

Another challenge would be to gather sufficient amount of samples for the research which is shown when survey 6 only have 504 participants which is half of the desired sample size. There were 38,817 cases where interviewers are unable to determine if the participant was eligible to participate in the survey despite having given pre-requisite requirement. This shows that the pre-requisite requirement should be more specific and less general. Additionally, 10,302 of the number dialed did not pass the initial requirement of it being a home number. These are potentially close to 50,000 cases of potential sample being wasted as there is not clear answer whether they are valid or not with time wasted in attempting to conduct the survey on them.

This might give rise to the cases of false negative as even though the interviewers are trained, they are unable to determine 38,817 of the cases. In addition, we can’t be sure that false positives exist in the cases which are deemed as valid.

***Possible Recommendation to Overcome Challenges***

We recommend that the researcher use the random-digit generated number and match it to an online telephone address database to search for valid respondent. This will allow them to match the information gathered from participant against reliable sources. If possible, cooperation from local government would be good in ensuring reliability of the source of data since they can verify the demographics of the participant.

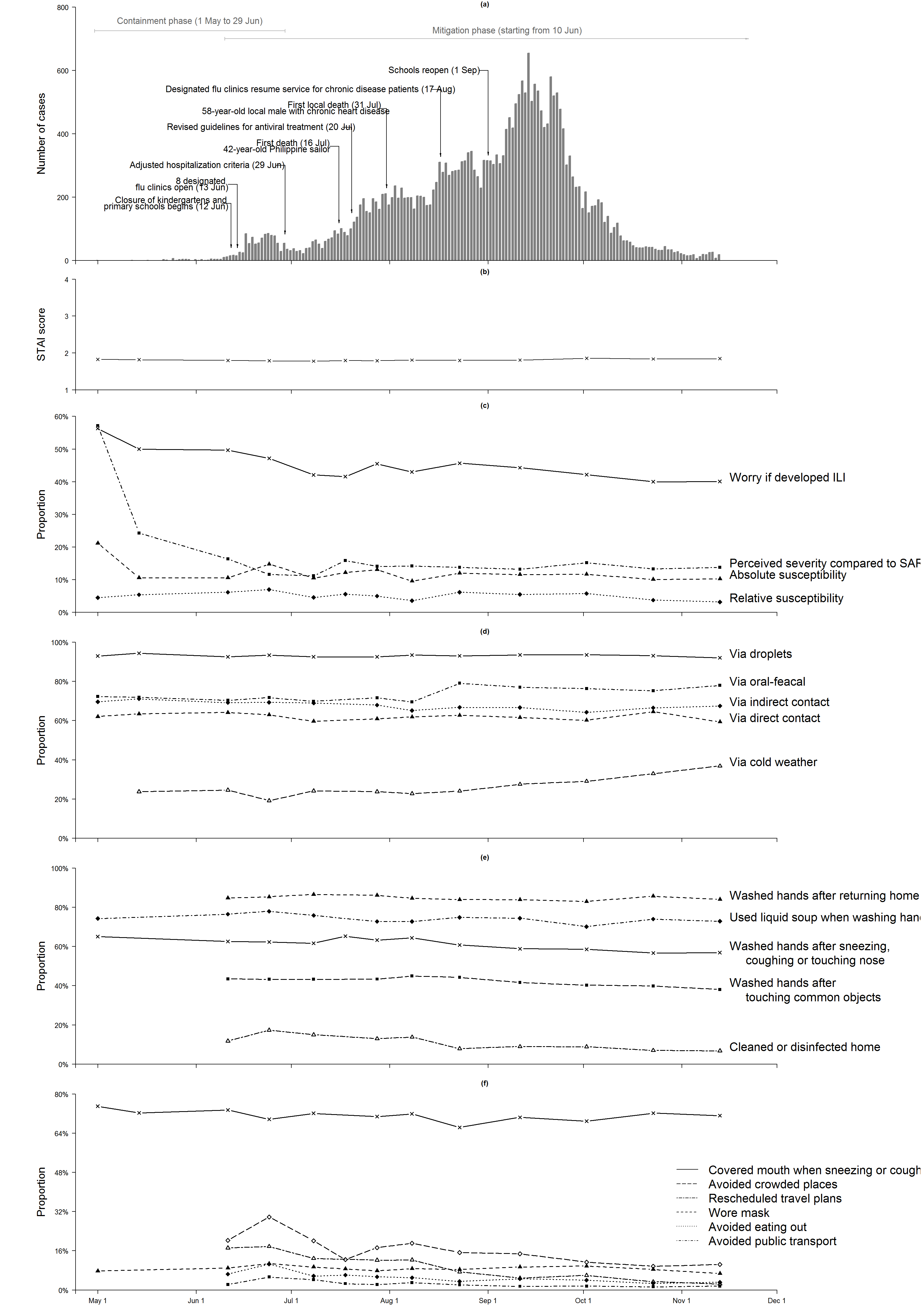
Electronic survey would be useful and can be used to test for consistency in answering the survey question which is similar to personality test and where they phase the same question differently to test for consistency. This is also better due to the fact that electronic survey remove interviewer biasness. Busy people also preferred to answer electronic survey compared to telephone surveys.[[2]](#footnote-2) It would reduce selection bias of the busy working class who would be unwilling to participate even though the call is made when they are at home.

We do not know the resource limitation of the research hence we do not know if these possible recommendations have already been thought of by the researcher.

**Plot Replication Details**

**Conclusion**

**Appendix A – Plot Replication**



**Appendix B – Table Replication**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Personal variables | handwashing after sneezing, coughing or touching nose | use liquid soup when washing hands | | wash hands after returning home | | wash hands after touching common objects | | clean or disinfect house more often |
| Male (n=4026) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| Female (n=6308) | 1.3 (1.18-1.43) | 1.36 (1.24-1.5) | | 1.55 (1.39-1.74) | | 1.79 (1.64-1.96) | | 1.03 (0.9-1.18) |
| Age Group (years) | | | | | | | | |
| 18 to 24 (n=1371) | 0.78 (0.66-0.91) | 0.47 (0.4-0.56) | | 0.37 (0.3-0.45) | | 0.51 (0.44-0.59) | | 0.95 (0.76-1.19) |
| 25 to 34 (n=1210) | 0.78 (0.67-0.92) | 1.1 (0.92-1.32) | | 0.76 (0.61-0.95) | | 0.77 (0.67-0.9) | | 1.01 (0.8-1.28) |
| 35 to 44 (n=1915) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| 45 to 54 (n=2575) | 1.01 (0.88-1.16) | 0.78 (0.68-0.9) | | 0.75 (0.62-0.9) | | 0.92 (0.81-1.04) | | 0.75 (0.62-0.92) |
| 55 to 64 (n=1787) | 1.24 (1.05-1.46) | 0.87 (0.74-1.02) | | 0.8 (0.65-0.99) | | 1.11 (0.96-1.27) | | 0.97 (0.79-1.2) |
| 65 or above (n=1377) | 1.34 (1.12-1.61) | 1.28 (1.07-1.55) | | 0.83 (0.66-1.04) | | 1.85 (1.58-2.17) | | 1.25 (0.98-1.58) |
| Educational Attainment | | | | | | | | |
| Primary or below (n=1801) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| Secondary (n=5317) | 1.01 (0.88-1.16) | 1.62 (1.42-1.85) | | 1.32 (1.12-1.56) | | 1.12 (1-1.27) | | 1.19 (0.98-1.44) |
| University or above (n=3123) | 0.91 (0.78-1.07) | 2 (1.71-2.34) | | 1.47 (1.22-1.78) | | 1.12 (0.97-1.29) | | 0.9 (0.72-1.13) |
| Anxiety score | | | | | | | | |
| Low (1.00-1.99) (n=6303) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| Medium (2.00-2.50) (n=2992) | 0.79 (0.71-0.87) | 0.83 (0.75-0.92) | | 0.83 (0.73-0.94) | | 0.86 (0.78-0.94) | | 1.17 (1.01-1.35) |
| High (2.50-4.00) (n=795) | 0.71 (0.6-0.84) | 0.85 (0.72-1.01) | | 0.69 (0.56-0.85) | | 0.9 (0.77-1.06) | | 1.41 (1.13-1.76) |
| Self-rated health | | | | | | | | |
| Excellent (n=1394) | 1.33 (1.13-1.56) | 1.12 (0.96-1.31) | | 1.12 (0.93-1.34) | | 1.23 (1.07-1.41) | | 1.06 (0.85-1.32) |
| Very Good (n=3021) | 1.17 (1.04-1.31) | 1.03 (0.92-1.17) | | 1.18 (1.02-1.37) | | 1.08 (0.97-1.21) | | 0.98 (0.82-1.16) |
| Good (n=2796) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| Fair (n=2763) | 1.08 (0.96-1.22) | 0.95 (0.84-1.08) | | 0.99 (0.85-1.15) | | 0.98 (0.87-1.1) | | 1.02 (0.86-1.21) |
| Poor (n=359) | 0.98 (0.76-1.27) | 0.94 (0.73-1.22) | | 1.36 (0.97-1.91) | | 0.99 (0.78-1.25) | | 0.82 (0.57-1.18) |
| Absolute susceptibility | | | | | | | | |
| Never (n=1173) | 1.09 (0.91-1.3) | 0.99 (0.83-1.18) | | 0.88 (0.71-1.09) | | 1 (0.85-1.18) | | 0.88 (0.68-1.13) |
| Very unlikely (n=823) | 0.99 (0.82-1.19) | 1 (0.82-1.21) | | 0.88 (0.7-1.1) | | 0.96 (0.81-1.14) | | 0.71 (0.53-0.96) |
| Unlikely (n=3207) | 0.91 (0.81-1.03) | 0.93 (0.83-1.06) | | 0.83 (0.71-0.96) | | 0.96 (0.86-1.07) | | 0.9 (0.76-1.07) |
| Even (n=3384) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| Likely (n=1086) | 0.93 (0.8-1.09) | 0.98 (0.83-1.15) | | 1.1 (0.89-1.36) | | 1.02 (0.88-1.18) | | 0.85 (0.68-1.06) |
| Very likely or certain (n=79) | 1.24 (0.72-2.14) | 1.43 (0.77-2.67) | | 0.84 (0.44-1.62) | | 1.67 (1.04-2.68) | | 1.42 (0.8-2.52) |
| Relative susceptibility | | | | | | | | |
| Not at all (n=1586) | 1.18 (0.99-1.41) | 1.18 (0.99-1.4) | | 1.15 (0.94-1.4) | | 1.26 (1.08-1.47) | | 1.23 (0.97-1.57) |
| Much less (n=1654) | 1.05 (0.91-1.22) | 0.98 (0.85-1.14) | | 1.3 (1.07-1.57) | | 1.13 (0.99-1.3) | | 1.13 (0.9-1.42) |
| Less (n=3004) | 1.06 (0.94-1.2) | 0.95 (0.84-1.07) | | 1.17 (1-1.35) | | 1.09 (0.97-1.22) | | 1.14 (0.96-1.35) |
| Even (n=2967) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| More (n=445) | 1.06 (0.85-1.32) | 1.27 (0.98-1.64) | | 1.06 (0.79-1.42) | | 1.03 (0.83-1.28) | | 1.5 (1.12-2) |
| Much more or certain (n=88) | 1.26 (0.77-2.06) | 1.65 (0.94-2.9) | | 1.16 (0.62-2.15) | | 1.32 (0.85-2.07) | | 2.43 (1.43-4.14) |
| Severity compared to SARS | | | | | | | | |
| Much less (n=4143) | 0.68 (0.58-0.8) | 0.76 (0.64-0.89) | | 0.89 (0.73-1.09) | | 0.78 (0.67-0.91) | | 0.71 (0.57-0.89) |
| Less (n=4591) | 0.88 (0.75-1.04) | 0.89 (0.75-1.05) | | 0.98 (0.8-1.21) | | 0.97 (0.83-1.12) | | 0.84 (0.68-1.04) |
| About the same (n=961) | 1.00 (reference) | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) | | 1.00 (reference) |
| More (n=365) | 1.04 (0.77-1.4) | 0.93 (0.7-1.24) | | 1.18 (0.82-1.71) | | 1.3 (1.01-1.67) | | 1.27 (0.91-1.76) |
| Much more (n=119) | 0.85 (0.54-1.33) | 1.29 (0.79-2.11) | | 0.89 (0.52-1.52) | | 1.08 (0.72-1.61) | | 1.48 (0.92-2.38) |
| Worry if develop ILI | | | | | | | | |
| Not at all worried (n=1467) | 0.95 (0.83-1.1) | 0.93 (0.8-1.07) | | 0.89 (0.75-1.05) | | 0.89 (0.78-1.02) | | 0.61 (0.45-0.81) |
| Much less worried than normal (n=214) | 1.15 (0.83-1.59) | 0.9 (0.66-1.23) | | 1.25 (0.83-1.88) | | 0.99 (0.74-1.33) | | 1.96 (1.27-3.01) |
| Worried less than normal (n=696) | 1.16 (0.95-1.41) | 1.31 (1.08-1.59) | | 1.06 (0.84-1.33) | | 1.08 (0.91-1.29) | | 1.22 (0.9-1.64) |
| Same (n=3257) |  | |  | |  | |  | |
| Worried more than normal (n=3535) | 1.08 (0.97-1.21) | 1.14 (1.02-1.27) | | 1.14 (0.99-1.3) | | 1.14 (1.03-1.27) | | 2.29 (1.94-2.71) |
| Worried much more than normal (n=681) | 1.05 (0.86-1.27) | 1.05 (0.86-1.27) | | 1.16 (0.91-1.48) | | 1.36 (1.14-1.62) | | 2.57 (2.02-3.27) |
| Extremely worried (n=423) | 1.06 (0.83-1.35) | 1.05 (0.83-1.34) | | 1.49 (1.07-2.07) | | 1.45 (1.17-1.79) | | 2.75 (2.07-3.64) |
| Modes of transmission | | | | | | | | |
| Droplets (n=9597) | 1.16 (0.93-1.44) | 1.03 (0.84-1.26) | | 0.95 (0.74-1.22) | | 1.03 (0.85-1.24) | | 0.71 (0.54-0.93) |
| Indirect hand contact (n=6414) | 1.07 (0.95-1.19) | 1.11 (1-1.24) | | 1.07 (0.94-1.21) | | 1.07 (0.97-1.18) | | 1.07 (0.91-1.24) |
| Oral-faecal (n=6987) | 1.12 (1-1.25) | 1.29 (1.15-1.45) | | 1.37 (1.2-1.57) | | 1.56 (1.41-1.73) | | 1.3 (1.1-1.54) |

**Appendix C – Plot Replication Code**

library(IDPmisc)

library(fields)

raw.cases <- read.csv("H1N1\_cum\_cases.csv")

survey <- read.csv("H1N1\_surveys.csv")

# get anxiety score for pandel 2

survey$ax1\_1.1 <- 5-survey$ax1\_1; survey$ax1\_2.1 <- 5-survey$ax1\_2; survey$ax1\_3.1 <- 5-survey$ax1\_3

survey$ax1\_4.1 <- 5-survey$ax1\_4; survey$ax1\_5.1 <- 5-survey$ax1\_5

survey$ascore <- rowMeans(survey[c("ax1\_1.1","ax1\_2.1","ax1\_3.1","ax1\_4.1","ax1\_5.1","ax1\_6","ax1\_7","ax1\_8","ax1\_9","ax1\_10")],na.rm=T)

anxiety <- rep(NA,13)

for(i in 1:13){

tmp <- survey[survey$wave==i,]

anxiety[i] <- round(mean(tmp$ascore\*tmp$wtageSG1,na.rm=T),2)

}

# for panel 3

# worry if develop ILI

worry <- absolute <- relative <- SARS <- rep(NA,13)

for(i in 1:13){

tmp <- survey[survey$wave==i,]

worry[i] <- round(sum((tmp$bf4>=5)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

if(i==1) absolute[i] <- round(sum((tmp$bf1<=2)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

else absolute[i] <- round(sum((tmp$bf1>=5)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

relative[i] <- round(sum((tmp$bf2>=5)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

SARS[i] <- round(sum((tmp$bf5>=3)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

}

# for pandel 4

droplets <- dhc <- ihc <- of <- cold <- NA

for(i in 1:13){

tmp <- survey[survey$wave==i,]

droplets[i] <- round(sum((tmp$bf3\_1==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

dhc[i] <- round(sum((tmp$bf3\_3==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

ihc[i] <- round(sum((tmp$bf3\_4==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

of[i] <- round(sum((tmp$bf3\_5==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

cold[i] <- round(sum((tmp$bf3\_9==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100 ###!!!

}

droplets[6] <- dhc[6] <- ihc[6] <- of[6] <- cold[1] <- cold[6] <- NA

# for panel 5

handwash <- handwashhome <- soup <- handwashtouch <- clean <- NA

for(i in 1:13){

tmp <- survey[survey$wave==i,]

handwash[i] <- round(sum((tmp$pm3<=2)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

handwashhome[i] <- round(sum((tmp$pm3a<=2)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

soup[i] <- round(sum((tmp$pm4<=2)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

handwashtouch[i] <- round(sum((tmp$pm7b<=2)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

clean[i] <- round(sum((tmp$pm10\_6==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

}

handwashhome[c(1:2,6)] <- NA; soup[c(2,6)] <- NA; handwashtouch[c(1:2,6)] <- NA; clean[c(1:2,6)] <- NA

# for panel 6

covermouth <- mask <- eatout <- publictransport <- crowded <- reschedule <- NA

for(i in 1:13){

tmp <- survey[survey$wave==i,]

covermouth[i] <- round(sum((tmp$pm2<=2)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

mask[i] <- round(sum((tmp$pm5<=2)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

eatout[i] <- round(sum((tmp$pm10\_1==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

publictransport[i] <- round(sum((tmp$pm10\_2==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

crowded[i] <- round(sum((tmp$pm10\_3==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

reschedule[i] <- round(sum((tmp$pm10\_5==1)\*tmp$wtageSG1,na.rm=T)/nrow(tmp),3)\*100

}

covermouth[6] <- NA; mask[2] <- NA; eatout[1:2] <- publictransport[1:2] <- crowded[1:2] <- NA; reschedule[c(1,2,6)] <- NA

###

survey <- data.frame(dates=c(1, 14, 42, 55, 69, 79, 89, 100, 115, 134, 155, 176, 197), # count manually from raw data

# The 7th date should be 84 (jitter a bit for plot)

# panel 2

anxiety=anxiety,

# panel 3

worry=worry,

absolute=absolute,

relative=relative,

SARS=SARS,

# panel 4

droplets=droplets,

dhc=dhc,

ihc=ihc,

of=of,

cold=cold,

# panel 5

handwash=handwash,

handwashhome=handwashhome,

soup=soup,

handwashtouch=handwashtouch,

clean=clean,

# panel 6

covermouth=covermouth,

mask=mask,

eatout=eatout,

publictransport=publictransport,

crowded=crowded,

reschedule=reschedule)

cases <- data.frame(day=1:206)

cases$total <- rep(0, 206)

for (i in 1:177){

cases$total[raw.cases$day[i]] <- raw.cases$Total[i]

}

# You may need to save the graph in a local place.

png("d:/fig5.png", width=17, height=24, units="in", res=200, bg="transparent")

layout(matrix(1:6, ncol=1), heights=c(0.8,1.6,1.35,1.35,1.35,1.35))

#1 epi curve

par(mar=c(1,7,1,0.5))

barplot(cases$total,

xlim=c(-4, 250), ylim=c(0,800),

col=gray(0.5), border=gray(0.5), width=0.6, space=2/3,

axes=FALSE, axisnames=FALSE,

ylab="", cex.lab=1)

axis(1, pos=0, at=c(-6,1,32,62,93,124,154,185,215), labels=rep("", 9), cex.axis=1)

axis(2, pos=-6, las=1, cex.axis=1.2)

mtext("Number of cases", side=2, line=0.5, cex=1.2)

title(main="(a)", cex.main=1.2)

az <- 0.3

cex.t <- 1.5 # changed to 1.5 from 1

cex.t2 <- 2

if (FALSE){

#school closure 12 June = 43

t1 <- 43

y1 <- 180

Arrows(t1,y1,t1,40, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t1-3,t1),c(y1,y1),lwd=1)

text (t1-18.5, y = y1+10, "Closure of kindergartens and ", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

text (t1-20.5, y = y1-10, "primary schools begins (12 Jun)", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

#designated fever clinics open 13 Jun = 45

t2 <- 45

y2 <- 240

Arrows(t2,y2,t2,40, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t2-3,t2),c(y2,y2),lwd=1)

text (t2-11.5, y = y2+10, "8 designated", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

text (t2-17.5, y = y2-10, "flu clinics open (13 Jun)", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

#adjusted hospitalization criteria 29 Jun = 60

t3 <- 60

y3 <- 300

Arrows(t3,y3,t3,83, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t3-3,t3),c(y3,y3),lwd=1)

text (t3-24.5, y = y3, "Adjusted hospitalization criteria (29 Jun)", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

#first death 16 Jul = 77

t5 <- 77

y5 <- 360

Arrows(t5,y5,t5,118, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t5-3,t5),c(y5,y5),lwd=1)

text (t5-14.5, y = y5+10, "First death (16 Jul)", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

text (t5-19.5, y = y5-10, "42-year-old Philippine sailor", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

#revised guidelines for antiviral treatment 20 Jul = 81

t6 <- 81

y6 <- 420

Arrows(t6,y6,t6,150, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t6-3,t6),c(y6,y6),lwd=1)

text (t6-28.5, y = y6, "Revised guidelines for antiviral treatment (20 Jul)", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

#first local death 31 Jul = 92

t7 <- 92

y7 <- 480

Arrows(t7,y7,t7,229, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t7-3,t7),c(y7,y7),lwd=1)

text (t7-16.5, y = y7+10, "First local death (31 Jul)",adj = NULL, pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

text (t7-28.5, y = y7-10, "58-year-old local male with chronic heart disease",adj = NULL, pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

#flu clinics resumed service 17 Aug = 109

t8 <- 109

y8 <- 540

Arrows(t8,y8,t8,328, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t8-3,t8),c(y8,y8),lwd=1)

text (t8-41, y = y8, "Designated flu clinics resume service for chronic disease patients (17 Aug)", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

#school reopen 1 Sep = 124

t8 <- 124

y8 <- 600

Arrows(t8,y8,t8,332, size = az, width = 2.8, open = F,sh.adj=1,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo="Black", verbose=T)

lines(c(t8-3,t8),c(y8,y8),lwd=1)

text (t8-17, y = y8, "Schools reopen (1 Sep)", adj = NULL,

pos = NULL, offset = 0.4, vfont = NULL, cex = cex.t, col = NULL, font = NULL)

}

# containment phase: to 29 Jun (0-90)

tc1 <- 0

tc2 <- 60

ytc <- 725

lines(c(tc1,tc2),c(ytc,ytc),col=gray(0.7))

lines(c(tc1,tc1),c(ytc-5,ytc+5),col=gray(0.7))

lines(c(tc2,tc2),c(ytc-5,ytc+5),col=gray(0.7))

text (30, y =ytc+30, "Containment phase (1 May to 29 Jun)", adj = NULL,

pos = NULL, offset = 0.5, vfont = NULL,cex = 1.5\*cex.t, col =gray(0.4), font = NULL)

# mitigation phase: 10 Jun to (41- )

tm1 <- 41

tm2 <- 206

ytm <- 700

Arrows(tm1,ytm,tm2,ytm,size=az,width=2.8,open=T,sh.adj=0,sh.lwd=1,sh.lty=1,h.lwd=1,h.col.bo=gray(0.7),sh.col=gray(0.7),verbose=T)

lines(c(tm1,tm1),c(ytm-5,ytm+5),col=gray(0.7))

text (130, y =ytm+25, "Mitigation phase (starting from 10 Jun)", adj = NULL,

pos = NULL, offset = 0.5, vfont = NULL,cex = 1.5\*cex.t, col = gray(0.4), font = NULL)

#2 anxiety level

par(mar=c(1,7,1,0.5))

plot(NA, type="n", axes=FALSE, xlim=c(-4, 250), ylim=c(1, 4),

ylab="", cex.lab=1)

lines(survey$dates, survey$anxiety, type="b", pch=4, cex=1.1)

axis(1, pos=1, at=c(-6,1,32,62,93,124,154,185,215), labels=rep("", 9), cex.axis=1)

axis(2, pos=-6, at=1:4, las=1, cex.axis=1.2)

mtext("STAI score", side=2, line=0.5, cex=1.2)

title(main="(b)", cex.main=1.2)

#3 worry, absolute & relative susceptibility, severity compared to SARS

par(mar=c(1,7,1,0.5))

plot(NA, type="n", axes=FALSE, xlim=c(-4, 250), ylim=c(0, 60), xlab="", ylab="", cex.lab=1)

lines(survey$dates, survey$worry, lwd=1.5, type="b", pch=4, cex=1.1)

lines(survey$dates, survey$absolute, lty=2, lwd=1.5, type="b", pch=17, cex=1.4)

lines(survey$dates, survey$relative, lty=3, lwd=1.5, type="b", pch=18, cex=1.8)

lines(survey$dates, survey$SARS, lty=4, lwd=1.5, type="b", pch=15, cex=1.1)

axis(1, pos=0, at=c(-6,1,32,62,93,124,154,185,215), labels=rep("", 9), cex.axis=1)

axis(2, pos=-6, at=0:6\*10,

labels=paste(0:6\*10, "%", sep=""), las=1, cex.axis=1.2)

mtext("Proportion", side=2, line=0.5, cex=1.2)

text(200,survey$worry[13],"Worry if developed ILI",cex=cex.t2,adj = c(0,0))

text(200,survey$SARS[13],"Perceived severity compared to SARS",cex=cex.t2,adj = c(0,0))

text(200,survey$absolute[13],"Absolute susceptibility",cex=cex.t2,adj = c(0,0))

text(200,survey$relative[13],"Relative susceptibility",cex=cex.t2,adj = c(0,0))

title(main="(c)", cex.main=1.2)

#4 knowledge

par(mar=c(1,7,1,0.5))

plot(NA, type="n", axes=FALSE, xlim=c(-4, 250), ylim=c(0, 100), xlab="", ylab="", cex.lab=1)

lines(survey$dates[-c(6)], survey$droplets[-c(6)], lwd=1.5, type="b", pch=4, cex=1.1)

lines(survey$dates[-c(6)], survey$dhc[-c(6)],lty=2, lwd=1.5, type="b", pch=17, cex=1.4)

lines(survey$dates[-c(6)], survey$ihc[-c(6)],lty=3, lwd=1.5, type="b", pch=18, cex=1.8)

lines(survey$dates[-c(6)], survey$of[-c(6)],lty=4, lwd=1.5, type="b", pch=15, cex=1.1)

lines(survey$dates[-c(6)], survey$cold[-c(6)],lty=5, lwd=1.5, type="b", pch=2, cex=1.1)

axis(1, pos=0, at=c(-6,1,32,62,93,124,154,185,215), labels=rep("", 9), cex.axis=1)

axis(2, pos=-6, at=0:5/5\*100,

labels=paste(0:5/5\*100, "%", sep=""), las=1, cex.axis=1.2)

mtext("Proportion", side=2, line=0.5, cex=1.2)

text(200,survey$droplets[13],"Via droplets",cex=cex.t2,adj = c(0,0))

text(200,survey$of[13],"Via oral-feacal",cex=cex.t2,adj = c(0,0))

text(200,survey$ihc[13],"Via indirect contact",cex=cex.t2,adj = c(0,0))

text(200,survey$dhc[13],"Via direct contact",cex=cex.t2,adj = c(0,0))

text(200,survey$cold[13],"Via cold weather",cex=cex.t2,adj = c(0,0))

title(main="(d)", cex.main=1.2)

#5 personal hygiene

par(mar=c(1,7,1,0.5))

plot(NA, type="n", axes=FALSE, xlim=c(-4, 250), ylim=c(0, 100), xlab="", ylab="", cex.lab=1)

lines(survey$dates[-c(2)], survey$handwash[-c(2)], lwd=1.5, type="b", pch=4, cex=1.1)

lines(survey$dates[-c(6)], survey$handwashhome[-c(6)], lty=2, lwd=1.5, type="b", pch=17, cex=1.4)

lines(survey$dates[-c(2,6)], survey$soup[-c(2,6)], lty=4, lwd=1.5, type="b", pch=18, cex=1.8)

lines(survey$dates[-c(1,2,6)], survey$handwashtouch[-c(1,2,6)], lty=5, lwd=1.5, type="b", pch=15, cex=1.1)

lines(survey$dates[-c(6)], survey$clean[-c(6)], lty=6, lwd=1.5, type="b", pch=2, cex=1.1)

text(200,survey$handwashhome[13],"Washed hands after returning home",cex=cex.t2,adj = c(0,0))

text(200,survey$soup[13],"Used liquid soup when washing hands",cex=cex.t2,adj = c(0,0))

text(200,survey$handwash[13],"Washed hands after sneezing,

coughing or touching nose",cex=cex.t2,adj = c(0,0.5))

text(200,survey$handwashtouch[13],"Washed hands after

touching common objects",cex=cex.t2,adj = c(0,0.5))

text(200,survey$clean[13],"Cleaned or disinfected home",cex=cex.t2,adj = c(0,0))

axis(1, pos=0, at=c(-6,1,32,62,93,124,154,185,215), labels=rep("", 9), cex.axis=1)

axis(2, pos=-6, at=0:5/5\*100,labels=paste(0:5/5\*100, "%", sep=""), las=1, cex.axis=1.2)

mtext("Proportion", side=2, line=0.5, cex=1.2)

title(main="(e)", cex.main=1.2)

#6 social distancing

par(mar=c(1,7,1,0.5))

plot(NA, type="n", axes=FALSE, xlim=c(-4, 250), ylim=c(0, 80), xlab="", ylab="", cex.lab=1)

lines(survey$dates[-c(6)], survey$covermouth[-c(6)], lwd=1.5, type="b", pch=4, cex=1.1)

lines(survey$dates[-c(2)], survey$mask[-c(2)], lty=2, lwd=1.5, type="b", pch=17, cex=1.4)

lines(survey$dates[-c(1,2)], survey$eatout[-c(1,2)], lty=3, lwd=1.5, type="b", pch=18, cex=1.8)

lines(survey$dates[-c(1,2)], survey$publictransport[-c(1,2)], lty=4, lwd=1.5, type="b", pch=15, cex=1.1)

lines(survey$dates[-c(1,2)], survey$crowded[-c(1,2)], lty=5, lwd=1.5, type="b", pch=5, cex=1.1)

lines(survey$dates[-c(1,2,6)], survey$reschedule[-c(1,2,6)], lty=6, lwd=1.5, type="b", pch=24, cex=1.1)

legend(180,55,legend=c("Covered mouth when sneezing or coughing","Avoided crowded places","Rescheduled travel plans","Wore mask","Avoided eating out","Avoided public transport"),lty=c(1,5,6,2,3,4),lwd=1.2,bty="n",cex=cex.t2)

axis(1, pos=0, at=c(-6,1,32,62,93,124,154,185,215), labels=c("","May 1","Jun 1",

"Jul 1","Aug 1","Sep 1","Oct 1","Nov 1","Dec 1"), cex.axis=1.2)

axis(2, pos=-6, at=0:5/5\*80, labels=paste(0:5/5\*80, "%", sep=""), las=1, cex.axis=1.2)

mtext("Proportion", side=2, line=0.5, cex=1.2)

title(main="(f)", cex.main=1.2)

dev.off()

# End of script

**Appendix D – Table Replication Code**

# Data Preparation

survey <- read.csv("H1N1\_surveys.csv") #12965 observations

subset <- survey[survey$wave>2,] # Survey waves in mitigation phase, 10940 observations

for (waveIndex in 2:13){ # Suvery waves with >=1000 success respondents, 10436 observations

if(sum(survey$wave==waveIndex)<1000)

subset <- subset[subset$wave!=waveIndex,]

}

subset$sick <- 1\*((subset$sm1\_1==1&subset$sm1\_5==1)|(subset$sm1\_1==1&subset$sm1\_9==1)) # New attribute: sick=fever+cough OR fever+sore throat

subset <- subset[subset$sick==0&!is.na(subset$sick),] # Exclude sick/unknown status, 10334 observations

# Data validity check: Convert unauthorized data to NA

set12 <- c(1:2) #1-Yes; 2-No

subset$bf3\_1[!is.element(subset$bf3\_1,set12)] <- NA # Only Response 1 and 2 are valid for qn bf3\_1

subset$bf3\_3[!is.element(subset$bf3\_3,set12)] <- NA

subset$bf3\_4[!is.element(subset$bf3\_4,set12)] <- NA

subset$bf3\_5[!is.element(subset$bf3\_5,set12)] <- NA

subset$bf3\_6[!is.element(subset$bf3\_6,set12)] <- NA

set14<-c(1:4) #1-Always; 2-Usually; 3-Sometimes; 4-Never

subset$pm2[!is.element(subset$pm2,set14)] <- NA

subset$pm3[!is.element(subset$pm3,set14)] <- NA

subset$pm3a[!is.element(subset$pm3a,set14)] <- NA

subset$pm4[!is.element(subset$pm4,set14)] <- NA

subset$pm5[!is.element(subset$pm5,set14)] <- NA

subset$pm7[!is.element(subset$pm7,set14)] <- NA

subset$pm7b[!is.element(subset$pm7b,set14)] <- NA

set13<-c(1:3) #1-Yes, due to swine flu; 2-Yes, but not due to swine flu; 3-No

subset$pm10\_1[!is.element(subset$pm10\_1,set13)] <- NA

subset$pm10\_2[!is.element(subset$pm10\_2,set13)] <- NA

subset$pm10\_3[!is.element(subset$pm10\_3,set13)] <- NA

subset$pm10\_5[!is.element(subset$pm10\_5,set13)] <- NA

subset$pm10\_6[!is.element(subset$pm10\_6,set13)] <- NA

rm(set12,set13,set14)

# For invalid data, cary out Multiple Imputation using Additive Regression, Bootstrapping, and Predictive Mean Matching

library(Hmisc)

set.seed(12345) # same as the Original R script

subset.i <- aregImpute( ~ I(pm3)+I(pm5)+sex+I(age\_gp)+I(edu)+I(ax1\_1)+I(ax1\_2)+I(ax1\_3)+I(ax1\_4)+I(ax1\_5)+I(ax1\_6)+I(ax1\_7)+I(ax1\_8)+I(ax1\_9)+I(ax1\_10)

+I(ph1)+I(bf1)+I(bf2)+I(pm2)+I(pm3a)+I(pm4)+I(pm7)+I(pm7b)+I(pm10\_1)+I(pm10\_2)+I(pm10\_3)+I(pm10\_5)+I(pm10\_6)

+I(bf5)+I(bf4)+I(bf3\_1)+I(bf3\_3)+I(bf3\_4)+wave,#AsIs for each category

data=subset,

n.impute=10) #number of multiple imputations per missing value

subset.nomiss <- list(subset, subset, subset, subset, subset, subset, subset, subset, subset, subset)

for(i in 1:10){

subset.nomiss[[i]]$pm3[is.na(subset.nomiss[[i]]$pm3)] <- subset.i$imputed$pm3[,i]

subset.nomiss[[i]]$pm3a[is.na(subset.nomiss[[i]]$pm3a)] <- subset.i$imputed$pm3a[,i]

subset.nomiss[[i]]$pm4[is.na(subset.nomiss[[i]]$pm4)] <- subset.i$imputed$pm4[,i]

subset.nomiss[[i]]$pm5[is.na(subset.nomiss[[i]]$pm5)] <- subset.i$imputed$pm5[,i]

subset.nomiss[[i]]$pm7[is.na(subset.nomiss[[i]]$pm7)] <- subset.i$imputed$pm7[,i]

subset.nomiss[[i]]$pm7b[is.na(subset.nomiss[[i]]$pm7b)] <- subset.i$imputed$pm7b[,i]

subset.nomiss[[i]]$sex[is.na(subset.nomiss[[i]]$sex)] <- subset.i$imputed$sex[,i]

subset.nomiss[[i]]$age\_gp[is.na(subset.nomiss[[i]]$age\_gp)] <- subset.i$imputed$age\_gp[,i]

subset.nomiss[[i]]$edu[is.na(subset.nomiss[[i]]$edu)] <- subset.i$imputed$edu[,i]

subset.nomiss[[i]]$ax1\_1[is.na(subset.nomiss[[i]]$ax1\_1)] <- subset.i$imputed$ax1\_1[,i]

subset.nomiss[[i]]$ax1\_2[is.na(subset.nomiss[[i]]$ax1\_2)] <- subset.i$imputed$ax1\_2[,i]

subset.nomiss[[i]]$ax1\_3[is.na(subset.nomiss[[i]]$ax1\_3)] <- subset.i$imputed$ax1\_3[,i]

subset.nomiss[[i]]$ax1\_4[is.na(subset.nomiss[[i]]$ax1\_4)] <- subset.i$imputed$ax1\_4[,i]

subset.nomiss[[i]]$ax1\_5[is.na(subset.nomiss[[i]]$ax1\_5)] <- subset.i$imputed$ax1\_5[,i]

subset.nomiss[[i]]$ax1\_6[is.na(subset.nomiss[[i]]$ax1\_6)] <- subset.i$imputed$ax1\_6[,i]

subset.nomiss[[i]]$ax1\_7[is.na(subset.nomiss[[i]]$ax1\_7)] <- subset.i$imputed$ax1\_7[,i]

subset.nomiss[[i]]$ax1\_8[is.na(subset.nomiss[[i]]$ax1\_8)] <- subset.i$imputed$ax1\_8[,i]

subset.nomiss[[i]]$ax1\_9[is.na(subset.nomiss[[i]]$ax1\_9)] <- subset.i$imputed$ax1\_9[,i]

subset.nomiss[[i]]$ax1\_10[is.na(subset.nomiss[[i]]$ax1\_10)] <- subset.i$imputed$ax1\_10[,i]

subset.nomiss[[i]]$ph1[is.na(subset.nomiss[[i]]$ph1)] <- subset.i$imputed$ph1[,i]

subset.nomiss[[i]]$bf1[is.na(subset.nomiss[[i]]$bf1)] <- subset.i$imputed$bf1[,i]

subset.nomiss[[i]]$bf2[is.na(subset.nomiss[[i]]$bf2)] <- subset.i$imputed$bf2[,i]

subset.nomiss[[i]]$pm10\_1[is.na(subset.nomiss[[i]]$pm10\_1)] <- subset.i$imputed$pm10\_1[,i]

subset.nomiss[[i]]$pm10\_2[is.na(subset.nomiss[[i]]$pm10\_2)] <- subset.i$imputed$pm10\_2[,i]

subset.nomiss[[i]]$pm10\_3[is.na(subset.nomiss[[i]]$pm10\_3)] <- subset.i$imputed$pm10\_3[,i]

subset.nomiss[[i]]$pm10\_5[is.na(subset.nomiss[[i]]$pm10\_5)] <- subset.i$imputed$pm10\_5[,i]

subset.nomiss[[i]]$pm10\_6[is.na(subset.nomiss[[i]]$pm10\_6)] <- subset.i$imputed$pm10\_6[,i]

subset.nomiss[[i]]$bf5[is.na(subset.nomiss[[i]]$bf5)] <- subset.i$imputed$bf5[,i]

subset.nomiss[[i]]$bf4[is.na(subset.nomiss[[i]]$bf4)] <- subset.i$imputed$bf4[,i]

subset.nomiss[[i]]$bf3\_1[is.na(subset.nomiss[[i]]$bf3\_1)] <- subset.i$imputed$bf3\_1[,i]

subset.nomiss[[i]]$bf3\_3[is.na(subset.nomiss[[i]]$bf3\_3)] <- subset.i$imputed$bf3\_3[,i]

subset.nomiss[[i]]$bf3\_4[is.na(subset.nomiss[[i]]$bf3\_4)] <- subset.i$imputed$bf3\_4[,i]

}

anxiety <- cbind(subset$ax1\_1, subset$ax1\_2, subset$ax1\_3, subset$ax1\_4, subset$ax1\_5, subset$ax1\_6, subset$ax1\_7, subset$ax1\_8, subset$ax1\_9, subset$ax1\_10)

for (i in 1:10){

# anxiety

subset.nomiss[[i]]$ax1\_1 <- 5-subset.nomiss[[i]]$ax1\_1

subset.nomiss[[i]]$ax1\_2 <- 5-subset.nomiss[[i]]$ax1\_2

subset.nomiss[[i]]$ax1\_3 <- 5-subset.nomiss[[i]]$ax1\_3

subset.nomiss[[i]]$ax1\_4 <- 5-subset.nomiss[[i]]$ax1\_4

subset.nomiss[[i]]$ax1\_5 <- 5-subset.nomiss[[i]]$ax1\_5

subset.nomiss[[i]]$ax1\_score <- (subset.nomiss[[i]]$ax1\_1+subset.nomiss[[i]]$ax1\_2+subset.nomiss[[i]]$ax1\_3+subset.nomiss[[i]]$ax1\_4+subset.nomiss[[i]]$ax1\_5+subset.nomiss[[i]]$ax1\_6+subset.nomiss[[i]]$ax1\_7+subset.nomiss[[i]]$ax1\_8+subset.nomiss[[i]]$ax1\_9+subset.nomiss[[i]]$ax1\_10)/10

subset.nomiss[[i]]$ax1\_score[subset.nomiss[[i]]$ax1\_score<2] <- 1

subset.nomiss[[i]]$ax1\_score[subset.nomiss[[i]]$ax1\_score>=2&subset.nomiss[[i]]$ax1\_score<2.5] <- 2

subset.nomiss[[i]]$ax1\_score[subset.nomiss[[i]]$ax1\_score>=2.5&subset.nomiss[[i]]$ax1\_score<=4] <- 3

# sex ref:M

subset.nomiss[[i]]$sex[subset.nomiss[[i]]$sex==1] <- 0

subset.nomiss[[i]]$sex[subset.nomiss[[i]]$sex==2] <- 1

# age ref: 35-44

subset.nomiss[[i]]$age\_gp[subset.nomiss[[i]]$age\_gp==3] <- 0

# education ref:primary

subset.nomiss[[i]]$edu[subset.nomiss[[i]]$edu<=3] <- 1

subset.nomiss[[i]]$edu[subset.nomiss[[i]]$edu<=6&subset.nomiss[[i]]$edu>=4] <- 2

subset.nomiss[[i]]$edu[subset.nomiss[[i]]$edu==7] <- 3

# perceived health

subset.nomiss[[i]]$ph1[subset.nomiss[[i]]$ph1==3] <- 0

# absolute susceptibility

subset.nomiss[[i]]$bf1[subset.nomiss[[i]]$bf1==4] <- 0

subset.nomiss[[i]]$bf1[subset.nomiss[[i]]$bf1==7] <- 6

# relative susceptibility

subset.nomiss[[i]]$bf2[subset.nomiss[[i]]$bf2==4] <- 0

subset.nomiss[[i]]$bf2[subset.nomiss[[i]]$bf2==7] <- 6

# severity vs SARS

subset.nomiss[[i]]$bf5[subset.nomiss[[i]]$bf5==3] <- 0

# how worry if developed ILI tomorrow

subset.nomiss[[i]]$bf4[subset.nomiss[[i]]$bf4==4] <- 0

# knowledge

subset.nomiss[[i]]$bf3\_1[subset.nomiss[[i]]$bf3\_1==2] <- 0

subset.nomiss[[i]]$bf3\_3[subset.nomiss[[i]]$bf3\_3==2] <- 0

subset.nomiss[[i]]$bf3\_4[subset.nomiss[[i]]$bf3\_4==2] <- 0

# cover mouth

subset.nomiss[[i]]$pm2[subset.nomiss[[i]]$pm2<=2] <- 1

subset.nomiss[[i]]$pm2[subset.nomiss[[i]]$pm2>=3&subset.nomiss[[i]]$pm2<=4] <- 0

# handwashing after sneezing

subset.nomiss[[i]]$pm3[subset.nomiss[[i]]$pm3<=2] <- 1

subset.nomiss[[i]]$pm3[subset.nomiss[[i]]$pm3>=3&subset.nomiss[[i]]$pm3<=4] <- 0

# handwashing after home

subset.nomiss[[i]]$pm3a[subset.nomiss[[i]]$pm3a<=2] <- 1

subset.nomiss[[i]]$pm3a[subset.nomiss[[i]]$pm3a>=3&subset.nomiss[[i]]$pm3a<=4] <- 0

# handwashing - use liquid soup

subset.nomiss[[i]]$pm4[subset.nomiss[[i]]$pm4<=2] <- 1

subset.nomiss[[i]]$pm4[subset.nomiss[[i]]$pm4>=3&subset.nomiss[[i]]$pm4<=4] <- 0

# wear mask

subset.nomiss[[i]]$pm5[subset.nomiss[[i]]$pm5<=2] <- 1

subset.nomiss[[i]]$pm5[subset.nomiss[[i]]$pm5>=3&subset.nomiss[[i]]$pm5<=4] <- 0

# adopt any preventive measures when touching common objects (pm7)

subset.nomiss[[i]]$pm7[subset.nomiss[[i]]$pm7<=2] <- 1

subset.nomiss[[i]]$pm7[subset.nomiss[[i]]$pm7>=3&subset.nomiss[[i]]$pm7<=4] <- 0

# wash hands after toucning common objects (pm7b)

subset.nomiss[[i]]$pm7b[subset.nomiss[[i]]$pm7b<=2] <- 1

subset.nomiss[[i]]$pm7b[subset.nomiss[[i]]$pm7b>=3&subset.nomiss[[i]]$pm7b<=4] <- 0

# distancing

subset.nomiss[[i]]$pm10\_1[subset.nomiss[[i]]$pm10\_1>=2&subset.nomiss[[i]]$pm10\_1<=3] <- 0

subset.nomiss[[i]]$pm10\_2[subset.nomiss[[i]]$pm10\_2>=2&subset.nomiss[[i]]$pm10\_2<=3] <- 0

subset.nomiss[[i]]$pm10\_3[subset.nomiss[[i]]$pm10\_3>=2&subset.nomiss[[i]]$pm10\_3<=3] <- 0

subset.nomiss[[i]]$pm10\_5[subset.nomiss[[i]]$pm10\_5>=2&subset.nomiss[[i]]$pm10\_5<=3] <- 0

subset.nomiss[[i]]$pm10\_6[subset.nomiss[[i]]$pm10\_6>=2&subset.nomiss[[i]]$pm10\_6<=3] <- 0

}

combine.mi <- function(model, n.impute){

betas <- matrix(c(model[[1]][[4]]$fixed, model[[2]][[4]]$fixed, model[[3]][[4]]$fixed,

model[[4]][[4]]$fixed, model[[5]][[4]]$fixed,model[[6]][[4]]$fixed, model[[7]][[4]]$fixed,

model[[8]][[4]]$fixed, model[[9]][[4]]$fixed, model[[10]][[4]]$fixed),

byrow=FALSE, ncol=n.impute) # beta

vars <- matrix(c(diag(model[[1]][[5]]), diag(model[[2]][[5]]), diag(model[[3]][[5]]),

diag(model[[4]][[5]]), diag(model[[5]][[5]]),diag(model[[6]][[5]]), diag(model[[7]][[5]]),

diag(model[[8]][[5]]), diag(model[[9]][[5]]), diag(model[[10]][[5]])),

byrow=FALSE, ncol=n.impute)

coef.names <- names(model[[1]][[4]]$fixed)

mean.coefs <- rowMeans(betas)

Ubar <- rowMeans(vars)

B <- rowSums((betas - mean.coefs)\*(betas-mean.coefs) /(n.impute - 1))

T <- (1 + 1/n.impute) \* B + Ubar

degf <- (n.impute - 1)\*(1 + Ubar / ((1 + 1/n.impute)\*B))\*(1 + Ubar / ((1 + 1/n.impute)\*B))

data.frame(OR = exp(mean.coefs),

lowerCI = exp(mean.coefs - qt(0.975, df=degf)\*sqrt(T))

,upperCI = exp(mean.coefs + qt(0.975, df=degf)\*sqrt(T))

#,p.value = 2\*(1 - pt(abs(mean.coefs)/sqrt(T), df=degf))

,row.names=coef.names)

}

library(MASS)

# handwashing after sneezing, coughing or touching nose

fit.m <- list(NA,NA,NA,NA,NA,NA,NA,NA,NA,NA,NA,NA,NA)

for (i in 1:10){

fit.m[[i]] <- glmmPQL(pm3~sex+factor(age\_gp)+factor(edu)+factor(ax1\_score)+

factor(ph1)+factor(bf1)+factor(bf2)+factor(bf5)+factor(bf4)+bf3\_1+bf3\_3+bf3\_4,

random = ~ 1 | wave, family = binomial,data=subset.nomiss[[i]])

}

round(combine.mi(fit.m,10),2)

# use liquid soup when washing hands

fit.m <- list(NA,NA,NA,NA,NA,NA,NA,NA,NA,NA,NA)

for (i in 1:10){

fit.m[[i]] <- glmmPQL(pm4~sex+factor(age\_gp)+factor(edu)+factor(ax1\_score)+

factor(ph1)+factor(bf1)+factor(bf2)+factor(bf5)+factor(bf4)+bf3\_1+bf3\_3+bf3\_4,

random = ~ 1 | wave, family = binomial,data=subset.nomiss[[i]])

}

round(combine.mi(fit.m,10),2)

# wash hands after returning home

fit.m <- list(NA,NA,NA,NA,NA,NA,NA,NA,NA,NA,NA)

for (i in 1:10){

fit.m[[i]] <- glmmPQL(pm3a~sex+factor(age\_gp)+factor(edu)+factor(ax1\_score)+

factor(ph1)+factor(bf1)+factor(bf2)+factor(bf5)+factor(bf4)+bf3\_1+bf3\_3+bf3\_4,

random = ~ 1 | wave, family = binomial,data=subset.nomiss[[i]])

}

round(combine.mi(fit.m,10),2)

# wash hands after toucning common objects (pm7b)

fit.m <- list(NA,NA,NA,NA,NA,NA,NA,NA,NA,NA,NA)

for (i in 1:10){

fit.m[[i]] <- glmmPQL(pm7b~sex+factor(age\_gp)+factor(edu)+factor(ax1\_score)+

factor(ph1)+factor(bf1)+factor(bf2)+factor(bf5)+factor(bf4)+bf3\_1+bf3\_3+bf3\_4,

random = ~ 1 | wave, family = binomial,data=subset.nomiss[[i]])

}

round(combine.mi(fit.m,10),2)

# clean or disinfect house more often

fit.m <- list(NA,NA,NA,NA,NA,NA,NA,NA,NA,NA,NA)

for (i in 1:10){

fit.m[[i]] <- glmmPQL(pm10\_6~sex+factor(age\_gp)+factor(edu)+factor(ax1\_score)+

factor(ph1)+factor(bf1)+factor(bf2)+factor(bf5)+factor(bf4)+bf3\_1+bf3\_3+bf3\_4,

random = ~ 1 | wave, family = binomial,data=subset.nomiss[[i]])

}

round(combine.mi(fit.m,10),2)

# End of script

**Appendix E – Articles Citing the Paper**

The paper is cited by 71 other articles, which are further cited in 525 articles. Name of articles which cite the paper and their respective citing data can be found in Google Scholar. Data is crawled using import.io extractor and can be found at <https://import.io/data/set/?mode=loadSet&set=ae925e4d-5f28-40d6-9860-cad50632bc39>. After data verification, the list is shown below:

|  |  |
| --- | --- |
| **Name of Article** | **Cited by** |
| Epidemiological characteristics of 2009 (H1N1) pandemic influenza based on paired sera from a longitudinal community cohort study | 82 |
| Factors affecting intention to receive and self-reported receipt of 2009 pandemic (H1N1) vaccine in Hong Kong: a longitudinal study | 79 |
| Acceptance of a vaccine against pandemic influenza A (H1N1) virus amongst healthcare workers in Beijing, China | 45 |
| Transmission characteristics of the 2009 H1N1 influenza pandemic: comparison of 8 Southern hemisphere countries | 40 |
| Did the pandemic have an impact on influenza vaccination attitude? A survey among health care workers | 38 |
| Computational epidemiology | 32 |
| The influence of social-cognitive factors on personal hygiene practices to protect against influenzas: using modelling to compare avian A/H5N1 and 2009 pandemic A/ … | 29 |
| Surveillance of perceptions, knowledge, attitudes and behaviors of the Italian adult population (18–69 years) during the 2009–2010 A/H1N1 influenza pandemic | 21 |
| Determinants of refusal of A/H1N1 pandemic vaccination in a high risk population: a qualitative approach | 17 |
| Facemasks and intensified hand hygiene in a German household trial during the 2009/2010 influenza A (H1N1) pandemic: adherence and tolerability in children and … | 12 |
| Knowledge, attitude, and behaviour of public health doctors towards pandemic influenza compared to the general population in Italy | 10 |
| Adoption of preventive measures during and after the 2009 influenza A (H1N1) virus pandemic peak in Spain | 10 |
| Examining the knowledge, attitudes and practices of domestic and international university students towards seasonal and pandemic influenza | 10 |
| The epidemiological and public health research response to 2009 pandemic influenza A (H1N1): experiences from Hong Kong | 8 |
| Human exposure to live poultry and psychological and behavioral responses to influenza A (H7N9), China | 8 |
| Prevalence and associated psychosocial factors of increased hand hygiene practice during the influenza A/H1N1 pandemic: findings and prevention … | 11 |
| How do anticipated worry and regret predict seasonal influenza vaccination uptake among Chinese adults? | 8 |
| Influenza-like illness in general practice in Norway: clinical course and attitudes towards vaccination and preventive measures during the 2009 pandemic | 6 |
| Responses to threat of influenza A (H7N9) and support for live poultry markets, Hong Kong, 2013 | 5 |
| Knowledge, risk perceptions, and preventive precautions among Hong Kong students during the 2009 influenza A (H1N1) pandemic | 5 |
| Anxiety and depression: linkages with viral diseases | 6 |
| Media Use and Communication Inequalities in a Public Health Emergency: A Case Study of 2009–2010 Pandemic Influenza A Virus Subtype H1N1. | 5 |
| Modelling the propagation of social response during a disease outbreak | 5 |
| Intentions to perform non-pharmaceutical protective behaviors during influenza outbreaks in Sweden: a cross-sectional study following a mass vaccination … | 5 |
| Controlling epidemic viral infection | 4 |
| Attitudes of the medical students from two Czech universities to pandemic flu A (H1N1) 2009 and to influenza vaccination | 3 |
| Non-pharmaceutical measures to prevent influenza transmission: the evidence for individual protective measures | 3 |
| Comparison of different risk perception measures in predicting seasonal influenza vaccination among Healthy Chinese adults in Hong Kong: a prospective … | 4 |
| Pandemic influenza A/H1N1 (pH1N1) in Hong Kong: Anatomy of a response | 3 |
| Effect of the H1N1 influenza pandemic on the incidence of epidemic keratoconjunctivitis and on hygiene behavior: a cross-sectional study | 3 |
| Anxiety, worry and cognitive risk estimate in relation to protective behaviors during the 2009 influenza A/H1N1 pandemic in Hong Kong: ten cross-sectional … | 5 |
| Dimensiones culturales del concepto de influenza humana en estudiantes y docentes de ciencias de la salud que favorecen o dificultan su prevención | 5 |
| 甲型 H1N1 流感不同流行时期农民知信行变化趋势分析 [J] | 4 |
| Contact behaviour of children and parental employment behaviour during school closures against the pandemic influenza A (H1N1-2009) in Japan | 3 |
| What have we learned about communication inequalities during the H1N1 pandemic: a systematic review of the literature | 3 |
| Attitudes and preventive behaviours adopted during the (H1N1) 2009 influenza virus epidemic in Spain | 3 |
| Health-care providers' preparedness for H1N1/09 influenza prevention and treatment in Dar es Salaam, Tanzania | 2 |
| Human behavior in epidemic modelling | 1 |
| The cost of double standard risk communication during the swine-flu epidemic: Reflections from Norway | 1 |
| Preventing the spread of H1N1 influenza infection during a pandemic: autonomy-supportive advice versus controlling instruction | 1 |
| Actitudes y comportamientos preventivos durante la pandemia de gripe (H1N1) 2009 en España | 1 |
| 城乡居民人感染 H7N9 禽流感知信行调查 | 1 |
| 甲型 H1N1 流感防控建模分析 | 1 |
| Modelling public adoption of health protective behaviours against novel respiratory infectious diseases in Hong Kong: the avianinfluenza A/H5N1 and the 2009 … | 0 |
| Swine Flu in College: Early Campus Response to Outbreak Control Measures | 0 |
| SYSTEMATIC REVIEW | 0 |
| Homo-psychologicus: Reactionary Behavioural Aspects | 0 |
| The effects of SNS communication: How expressing and receiving information predict MERS-preventive behavioral intentions in South Korea | 0 |
| Exploring the Effect of School Closure in Mitigating Transmission of Pandemic (H1N1) 2009 in Hong Kong | 0 |
| Health seeking behavioral response through post pandemic H1N1 period in Hong Kong | 0 |
| TELL ME Design: Protective Behaviour During an Epidemic | 0 |
| Survey on the Likely Behavioural Changes of the General Public in Four European Countries During the 2009/2010 Pandemic | 0 |
| Influenza vaccination and its association with Guillain-barréSyndrome | 0 |
| Responses to Threat of Influenza A(H7N9) and Support for Live Poultry Markets, Hong Kong, 2013 | 5 |
| Homo-psychologicus: Reactionary behavioural aspects of epidemics | 0 |
| Live Poultry Exposure and Public Response to Influenza A (H7N9) in Urban and Rural China during Two Epidemic Waves in 2013-2014 | 0 |
| Public risk perception and attitudes towards live poultry markets before and after their closure due to influenza A (H7N9), Hong Kong, January–February 2014 | 1 |
| Intention to receive influenza vaccination prior to the summer influenza season in adults of Hong Kong, 2015 | 0 |
| Authors response to Influence of country of study on student responsiveness to the H1N1 pandemic | 0 |
| Population Behavior Patterns in Response to the Risk of Influenza A (H7N9) in Hong Kong, December 2013–February 2014 | 0 |
| Knowledge, attitudes, and practices of Hong Kong population towards human A/H7N9 influenza pandemic preparedness, China, 2014 | 0 |
| Chinese Parents' Perspectives regarding Present and Later Life Diseases Prevention through Vaccination | 1 |
| The magazine archive includes every article published in Communications of the ACM for over the past 50 years. | 0 |
| ATTITUDES OF THE CZECH UNIVERSITY STUDENTS TO PANDEMIC FLU A (H1N1) 2009 AND TO INFLUENZA VACCINATION | 0 |
| Study on public perceptions and protective behaviors regarding Lyme disease among the general public in the Netherlands | 0 |
| Role of household factors in parental attitudes to pandemic influenza-related school closure in Japan: a cross-sectional study | 0 |
| 广州市涉禽食品从业人员在禽流感疫情前后的态度和行为变化的分析 | 0 |
| 以健康信念模式為基礎之流行性感冒衛教介入: 台灣北部高中生之隨機分派實驗 | 0 |
| 감염병 유행 시 학교 보건교육의 효율성 제고를 위한 전략 개발 | 0 |
| Dimensiones culturales del concepto de influenza humana en estudiantes y docentes deficiencias de la salud que favorecen o dificultan su prevención | 0 |
| Mesures non pharmaceutiques pour prévenir las transmission de la grippe: les données probantes en faveur des mesures de protection individuelle | 0 |

1. Hong Kong – the Facts (Aug, 2015),From http://www.gov.hk/en/about/abouthk/facts.htm [↑](#footnote-ref-1)
2. # Online, face-to-face and telephone surveys—Comparing different sampling methods in wine consumer research (Dec, 2013) from http://www.sciencedirect.com/science/article/pii/S2212977413000331

   [↑](#footnote-ref-2)