Using Andersen’s model of health care utilization to assess factors associated with COVID-19 testing among adults in nine low-and middle-income countries: an online survey

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The structure below is a possible setup for a data analysis project (including the course project). For a manuscript, adjust as needed.

# 1 Summary/Abstract

*Write a summary of your project.*

# 2 Introduction

## 2.1 General Background Information

This study aimed to investigate, using the Andersen’s model of health care utilization, factors associated with COVID-19 testing among adults in Bangladesh.

## 2.2 Description of data and data source

This will be a descriptive cross-sectional online study. To get data for this study, between 10 December 2020 and 9 February 2021 an online survey was organized in Bangladesh. In total 759 adults (median age 45 years, interquartile range 33-57 years, range 18-93 years), participated in the study. COVID-19 testing/infection status was assessed by self-report.

## 2.3 Questions/Hypotheses to be addressed

The main question is to find out the key factors associated with covid-19 testing

# 3 Methods and Results

*Study design, sample, and procedure*

This will be a descriptive cross-sectional online study conducted in Bangladesh between 10 December 2020 to 9 February 2021. Participant inclusion criteria were 18 years and older, any gender, and provision of electronic informed consent.

*Measures* Using Andersen’s model of health care utilization [Andersen 1995], study variables will be categorized into outcome variable, predisposing factors, enabling/disabling factors and need for care factors.

*Outcome variable* COVID-19 testing/infection status will be assessed with the question, “Since the beginning of the COVID-19 outbreak, do you have information on your infection status?” Response options were 1=not tested/does not know test results, 2=negative, and 3=positive.

*Predisposing factors* Sociodemographic factors included age, sex, country of residence, educational level, and the (estimated) age(s) of their housemate(s). Chronic/underlying diseases includs heart disease, hypertension, diabetes, cancer, HIV, tuberculosis, and chronic asthma; coded as “0” none and “1” at least presence of one clinically diagnosed condition.

*COVID-19 preventive measures* Participants were asked, “During the past 7 days, have you been observing any of the following preventive measures against COVID-19? 1) Social distancing of at least 1.5m, 2) Wearing a face mask, 3) Hand hygiene (regular handwashing with soap or using hand gel), and 4) Coughing hygiene (covering the mouth when coughing or sneezing). A composite non-adherence to all four COVID-19 preventive measure was calculated by coding each negative response with “1,” summing scores ranging from 0-4 (Cronbach’s alpha 0.7).

*Enabling/disabling factors* Enabling factors include self-perceived socio-economic status, self-perceived area of residence, being a student or worker in the health care sector, source of COVID-19 information/advice most trusted (coded as other, including family and friends, radio/TV, social media, religious authorities and health personnel.

*Disabling factors* include the assessment of psychological distress with the Patient Health Questionnaire (PHQ-4) for Depression and Anxiety symptoms [Kroenke/ Löwe]. The severity of psychological distress is categorized as normal (0-2), mild (3-5). moderate (6-8) and severe (9-12) based on the PHQ-4 scores.

*Need for care factors* include two questions on 1) the level of fear/worry of being infected with COVID-19 (ranging from 1=not at all worried to 5=extremely worried), and 2) having been quarantined (either at home or elsewhere) at any point in time during the COVID-19 epidemic.

*Data analysis*

Descriptive statistics will be used to describe the study population. Logistic regression will be used to assess associations between predisposing factors, enabling and disabling factors, need of care factors and COVID-19 testing status, COVID-19 positive versus negative status and COVID-19 positive versus negative and not tested status. Variables significant at <0.05 in univariate analyses were subsequently included in the multivariable logistic regression models. Statistical analyses will conducted using R.

## 3.1 Data aquisition

*As applicable, explain where and how you got the data. If you directly import the data from an online source, you can combine this section with the next.*

## 3.2 ## Data import and cleaning\_ [Here I mostly covered descriptive analysis]

title: “try” author: “Ehsan” date: “10/6/2021” output: html\_document —

library(ggplot2)  
library(tidyverse)

## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.1 ──

## ✓ tibble 3.1.4 ✓ dplyr 1.0.7  
## ✓ tidyr 1.1.3 ✓ stringr 1.4.0  
## ✓ readr 2.0.1 ✓ forcats 0.5.1  
## ✓ purrr 0.3.4

## ── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()

library("readxl")

data1 <- readxl::read\_excel('~/Study /MADA\_2021/EhsanSuez-MADA-project/data/raw\_data/Covid Vaccine data\_Bangladesh\_Abu\_Sayeed.xlsx')

#I want to see how many NA values are there for each column. So, I wrote the following code. For manuscript we dont need it. #```{r} cbind( lapply( lapply(data1, is.na) , sum) ) # #I want to see which columns have NA values

df <- as.data.frame(  
 cbind(  
 lapply(  
 lapply(data1, is.na), sum)  
 )  
 )  
rownames(subset(df, df$V1 != 0))

## [1] "Would you be willing to allow your children take the COVID-19 vaccine when it becomes available?: If it is at least 50% effective"  
## [2] "Would you be willing to allow your children take the COVID-19 vaccine when it becomes available?: If it is at least 75% effective"  
## [3] "Would you be willing to allow your children take the COVID-19 vaccine when it becomes available?: If it is at least 90% effective"  
## [4] "Would you be willing to allow your children take the COVID-19 vaccine when it becomes available?: If it is at least 95% effective"  
## [5] "Please specify other reasons for hesitating to receive the COVID-19 vaccine:"

#the mean age and SD of mean age:

mean(data1$Age)

## [1] 30.70963

sd(data1$Age)

## [1] 10.83175

#For each age group, whats their percentage?

data1 %>%   
 group\_by( Age ) %>%   
 summarise( percent = 100 \* n() / nrow( data1) )

## # A tibble: 53 × 2  
## Age percent  
## <dbl> <dbl>  
## 1 18 1.42  
## 2 19 2.12  
## 3 20 4.96  
## 4 21 4.39  
## 5 22 4.25  
## 6 23 5.95  
## 7 24 5.95  
## 8 25 9.77  
## 9 26 8.07  
## 10 27 4.53  
## # … with 43 more rows

#number of male and female

sum(data1$Sex=='Male')

## [1] 387

sum(data1$Sex=='Female')

## [1] 319

#percentage of male and female

data1 %>%   
 group\_by( Sex ) %>%   
 summarise( percent = 100 \* n() / nrow( data1) )

## # A tibble: 2 × 2  
## Sex percent  
## <chr> <dbl>  
## 1 Female 45.2  
## 2 Male 54.8

#number of people for each educational category

table(data1$`Highest educational level`)

##   
## Primary Secondary   
## 6 149   
## University Postgraduate degree holder University Undergraduate degree holder   
## 168 383

sum(data1$'Highest educational level' == 'Primary')

## [1] 6

sum(data1$'Highest educational level' == 'Secondary')

## [1] 149

sum(data1$'Highest educational level' == 'University Postgraduate degree holder')

## [1] 168

sum(data1$'Highest educational level' == 'University Undergraduate degree holder')

## [1] 383

#percentage of people for each student category

data1 %>%   
 group\_by( `Highest educational level` ) %>%   
 summarise( percent = 100 \* n() / nrow( data1) )

## # A tibble: 4 × 2  
## `Highest educational level` percent  
## <chr> <dbl>  
## 1 Primary 0.850  
## 2 Secondary 21.1   
## 3 University Postgraduate degree holder 23.8   
## 4 University Undergraduate degree holder 54.2

#student/worker in the heathcare sector?

table(data1$`Are you a student or worker in the healthcare sector?`)

##   
## No Yes   
## 480 226

#household members?

table(data1$`Who do you currently live with in the same household? Please select the number of persons in each age category.: 60 years and above`)

##   
## 0 1 2 3 4 5 6 7 10   
## 228 230 166 54 14 5 5 1 3

table(data1$`Who do you currently live with in the same household? Please select the number of persons in each age category.: 18 to 59 years`)

##   
## 0 1 2 3 4 5 6 7 8 9 10   
## 33 162 206 125 84 42 23 9 3 2 17

table(data1$`Who do you currently live with in the same household? Please select the number of persons in each age category.: 12 to 17 years`)

##   
## 0 1 2 3 4 5 6 7 8 10   
## 371 223 83 13 6 3 2 1 2 2

table(data1$`Who do you currently live with in the same household? Please select the number of persons in each age category.: Less than 12 years`)

##   
## 0 1 2 3 4 5 6 7 8 10   
## 372 205 84 22 7 6 3 2 2 3

table(data1$`Which of the following categories best describes your current socio-economic situation?`)

##   
## High income category Low income category   
## 45 54   
## Lower middle income category Upper middle income category   
## 259 348

sum(data1$'Which of the following categories best describes your current socio-economic situation?' == 'High income category')

## [1] 45

sum(data1$'Which of the following categories best describes your current socio-economic situation?' == 'Low income category')

## [1] 54

sum(data1$'Which of the following categories best describes your current socio-economic situation?' == 'Lower middle income category')

## [1] 259

sum(data1$'Which of the following categories best describes your current socio-economic situation?' == 'Upper middle income category ')

## [1] 0

#percentage of income category?

data1 %>%   
 group\_by( `Which of the following categories best describes your current socio-economic situation?` ) %>%   
 summarise( percent = 100 \* n() / nrow( data1) )

## # A tibble: 4 × 2  
## `Which of the following categories best describes your current socio-… percent  
## <chr> <dbl>  
## 1 High income category 6.37  
## 2 Low income category 7.65  
## 3 Lower middle income category 36.7   
## 4 Upper middle income category 49.3

table(data1$`Do you live in:`)

##   
## A rural place / village A Sub-urban setting / urban slum   
## 64 197   
## An urban setting / city / town   
## 445

sum(data1$'Do you live in:' == 'A rural place / village')

## [1] 64

sum(data1$'Do you live in:' == 'A Sub-urban setting / urban slum')

## [1] 197

sum(data1$'Do you live in:' == 'An urban setting / city / town')

## [1] 445

#percentage of living setup?

data1 %>%   
 group\_by( `Do you live in:` ) %>%   
 summarise( percent = 100 \* n() / nrow( data1) )

## # A tibble: 3 × 2  
## `Do you live in:` percent  
## <chr> <dbl>  
## 1 A rural place / village 9.07  
## 2 A Sub-urban setting / urban slum 27.9   
## 3 An urban setting / city / town 63.0

table(data1$`Which source of COVID-19 information/advice do you trust the most?`)

##   
## Family and friends   
## 21   
## Health personnel   
## 237   
## None of the above   
## 32   
## Other   
## 32   
## Radio / TV   
## 217   
## Religious authorities (Pastor, Priest, Imam, etc)   
## 16   
## Social Media (WhatsApp, Facebook, Twitter, etc)   
## 151

sum(data1$'Are you currently working/studying from home because of the COVID-19 outbreak?' == 'No')

## [1] 347

sum(data1$'Are you currently working/studying from home because of the COVID-19 outbreak?' == 'Yes')

## [1] 359

#percentage of work from home or not?

data1 %>%   
 group\_by( `Are you currently working/studying from home because of the COVID-19 outbreak?` ) %>%   
 summarise( percent = 100 \* n() / nrow( data1) )

## # A tibble: 2 × 2  
## `Are you currently working/studying from home because of the COVID-19… percent  
## <chr> <dbl>  
## 1 No 49.2  
## 2 Yes 50.8

#Descriptive analysis for each question?

table(data1$`Have you been quarantined (either at home or else where) at any point in time during the Covid-19 epidemic?`)

##   
## No Yes   
## 299 407

table(data1$`Since the beginning of the COVID-19 outbreak, do you have information on your infection status?`)

##   
## I was not tested / I don't know my test results   
## 445   
## I was tested negative   
## 197   
## I was tested positive   
## 64

table(data1$`How worried/fearful are you about becoming (re)infected by the coronavirus?: On a scale of 1 to 5`)

##   
## 1=Not at all worried 2=A little worried 3=Moderately worried   
## 125 256 230   
## 4=Very worried 5=Extremely worried   
## 77 18

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): Heart disease`)

##   
## No I Don't have this Disease X- Yes I have this Disease   
## 683 23

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): Hypertension`)

##   
## No I Don't have this Disease X- Yes I have this Disease   
## 643 63

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): Diabetes`)

##   
## No I Don't have this Disease X- Yes I have this Disease   
## 653 53

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): Cancer`)

##   
## No I Don't have this Disease X- Yes I have this Disease   
## 703 3

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): HIV`)

##   
## No I Don't have this Disease X- Yes I have this Disease   
## 705 1

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): Tuberculosis`)

##   
## No I Don't have this Disease X- Yes I have this Disease   
## 700 6

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): Asthma`)

##   
## No I Don't have this Disease X- Yes I have this Disease   
## 627 79

table(data1$`Do you have any of the following chronic/underlying diseases? (many answers possible): None of the above`)

##   
## I dont have #any\_of\_the\_previously\_mentioned Disease   
## 554   
## X- I have #at\_least\_one\_previously\_mentioned Disease   
## 152

table(data1$`During the past 7 days, have you been observing any of the following preventive measures against COVID-19? (Tick all answers that apply): Social distancing of at least 1.5m`)

##   
## No, I don't followed this measure X- Yes I followed this measure   
## 458 248

table(data1$`During the past 7 days, have you been observing any of the following preventive measures against COVID-19? (Tick all answers that apply): Wearing face mask`)

##   
## No, I don't followed this measure X- Yes I followed this measure   
## 65 641

table(data1$`During the past 7 days, have you been observing any of the following preventive measures against COVID-19? (Tick all answers that apply): Hand hygiene (regular handwashing with soap or using hand gel)`)

##   
## No, I don't followed this measure X- Yes I followed this measure   
## 100 606

table(data1$`During the past 7 days, have you been observing any of the following preventive measures against COVID-19? (Tick all answers that apply): Coughing hygiene (covering mouth when coughing or sneezing)`)

##   
## No, I don't followed this measure X- Yes I followed this measure   
## 163 543

table(data1$`During the past 7 days, have you been observing any of the following preventive measures against COVID-19? (Tick all answers that apply): None of the above`)

##   
## No, I don't followed #any\_of\_the\_previously\_mentioned measures   
## 17   
## X-Yes, I followed #any\_of\_the\_previously\_mentioned measures   
## 689

table(data1$`During the past two weeks, how often have you been bothered by each of the following symptoms?: Feeling down, depressed, or hopeless (low spirits)`)

##   
## More than half the days Nearly every day Not at all   
## 67 95 183   
## Several days   
## 361

table(data1$`During the past two weeks, how often have you been bothered by each of the following symptoms?: Little interest or pleasure in doing things`)

##   
## More than half the days Nearly every day Not at all   
## 72 73 219   
## Several days   
## 342

table(data1$`During the past two weeks, how often have you been bothered by each of the following symptoms?: Not being able to stop or control worrying`)

##   
## More than half the days Nearly every day Not at all   
## 46 70 369   
## Several days   
## 221

table(data1$`During the past two weeks, how often have you been bothered by each of the following symptoms?: Feeling nervous, anxious or on edge`)

##   
## More than half the days Nearly every day Not at all   
## 38 48 473   
## Several days   
## 147

table(data1$`In your opinion, can someone be re-infected with coronavirus after recovering from a previous COVID-19 infection?`)

##   
## I don't know No Yes   
## 115 54 537

table(data1$`In your opinion, can COVID-19 infection be prevented by a vaccine?`)

##   
## I don't know No Yes   
## 173 121 412

table(data1$`To the best of your knowledge, is there currently an effective vaccine against COVID-19?`)

##   
## I don't know No Yes   
## 192 120 394

table(data1$`Would you be willing to take the COVID-19 vaccine when it becomes available?: If it is at least 50% effective`)

##   
## No No opinion Yes   
## 357 147 202

table(data1$`Would you be willing to take the COVID-19 vaccine when it becomes available?: If it is at least 75% effective`)

##   
## No No opinion Yes   
## 310 142 254

table(data1$`Would you be willing to take the COVID-19 vaccine when it becomes available?: If it is at least 90% effective`)

##   
## No No opinion Yes   
## 220 137 349

table(data1$`Would you be willing to allow your children take the COVID-19 vaccine when it becomes available?: If it is at least 95% effective`)

##   
## No No opinion / not applicable   
## 69 107   
## Yes   
## 527

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): I don't think COVID-19 existsists`)

##   
## I think that #The\_COVID-19\_don't\_exists   
## 19   
## Its not a reason to me that #The\_COVID-19\_don't\_exists   
## 687

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): I think the vaccine is not effective`)

##   
## I think #the\_vaccine\_is\_not\_effective   
## 132   
## Its not a reason to me that #the\_vaccine\_is\_not\_effective   
## 574

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): I think the vaccine is designed to harm us`)

##   
## I think #the\_vaccine\_is designed to harm us   
## 33   
## Its not a reason to me that #the\_vaccine\_is designed to harm us   
## 673

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): I am scared of side-effects of the vaccine`)

##   
## I think #I\_am\_scared\_of\_side-effects-of the vaccine   
## 304   
## Its not a reason to me that #I\_am\_scared\_of\_side-effects-of the vaccine   
## 402

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): My body is naturally strong, I don't need a vaccine to fight COVID-19`)

##   
## I think #My\_body\_is\_naturally\_strong, I don't need a vaccine to fight COVID-19   
## 87   
## Its not a reason to me that #My\_body\_is\_naturally\_strong, I don't need a vaccine to fight COVID-19   
## 619

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): I already had COVID-19, so I think I am immune to the disease`)

##   
## I think #I\_already\_had\_COVID-19, so I think I am immune to the disease   
## 46   
## Its not a reason to me that #I\_already\_had\_COVID-19, so I think I am immune to the disease   
## 660

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): The COVID-19 pandemic is finished in my country, no need for a vaccine now`)

##   
## I think #The\_COVID-19\_pandemic\_is\_finished in my country, no need for a vaccine now   
## 33   
## Its not a reason to me that #The\_COVID-19\_pandemic\_is\_finished in my country, no need for a vaccine now   
## 673

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): None of the above`)

##   
## I marked at least one previously mentioned reason   
## 398   
## I think #no\_previously\_mentioned\_reason is suitable for me   
## 308

table(data1$`What are some of the possible reasons why you would hesitate to take the COVID-19 vaccine? (many answers possible): Other reasons (please specify)`)

##   
## I have #no\_othe\_reason for hesitation to take vaccine   
## 697   
## I have othe reason for hesitation to take vaccine   
## 9

table(data1$`Please specify other reasons for hesitating to receive the COVID-19 vaccine:`)

##   
## I am a lactating mother   
## 1   
## I have alergy in blood, also i have diabetics, so i am afraid of the side effect that i might get seriously ill or somethin. Also my son has asthma problem, i have heard the patients having diabetic, asthma, blood alergy are vulnerable to serious side e   
## 1   
## I'm not allowed to get vaccinated since my body reacts negatively to vaccine.   
## 1   
## vaccine নিয়ে কেউ সুস্থ হয়েছে এ নিউজ বিলিভ করি না   
## 1   
## উদাসীনতা   
## 1   
## কোনোরকম দ্বিধা ছাড়াই আমি কোভিশিল্ড ভ্যাকসিনের প্রথম ডোজ নিয়েছি গত ২০.০২.২০২১ তারিখে।   
## 1   
## তাওয়াক্কালতু আল্লাহ   
## 1   
## ভেজাল ভ্যাক্সিনের ভয়,   
## 1   
## ভ্যাকসিনের গবেষণা এখনো অসম্পূর্ণ বলে মনে করি।   
## 1

table(data1$`How important is it to you that by getting the COVID-19 vaccine, you would protect your own health?: On a scale of 1 to 5`)

##   
## 1=Not at all important 2=A little important 3=Moderately important   
## 33 41 131   
## 4=Very important 5=Extremely important   
## 196 305

table(data1$`How important is it to you that by getting the COVID-19 vaccine, you would protect the health of other people in your community?: On a scale of 1 to 5`)

##   
## 1=Not at all important 2=A little important 3=Moderately important   
## 26 36 129   
## 4=Very important 5=Extremely important   
## 269 246

table(data1$`I fully understand what this study is about, and I freely consent to participate. All the information I provide can be used by researchers to better understand coronavirus disease in my country.`)

##   
## Yes   
## 706

## 3.3 Exploratory analysis

*Use a combination of text/tables/figures to explore and describe your data. You should produce plots or tables or other summary quantities for the most interesting/important quantities in your data. Depending on the total number of variables in your dataset, explore all or some of the others. FIgures produced here might be histograms or density plots, correlation plots, etc. Tables might summarize your data.*

*Continue by creating plots or tables of the outcome(s) of interest and the predictor/exposure/input variables you are most interested in. If your dataset is small, you can do that for all variables. Plots produced here can be scatterplots, boxplots, violinplots, etc. Tables can be simple 2x2 tables or larger ones.*

*To get some further insight into your data, if reasonable you could compute simple statistics (e.g. t-tests, simple regression model with 1 predictor, etc.) to look for associations between your outcome(s) and each individual predictor variable. Though note that unless you pre-specified the outcome and main exposure, any “p<0.05 means statistical significance” interpretation is not valid.*

Table ?? shows a table summarizing the data.

#{r summarytable, echo=FALSE} #resulttable=readRDS("../../results/summarytable.rds") #knitr::kable(resulttable, caption = 'Data summary table.') #

Figure ?? shows a scatterplot figure produced by one of the R scripts.

#{r resultfigure, fig.cap='Analysis figure.', echo=FALSE} #knitr::include\_graphics("../../results/resultfigure.png") #

## 3.4 Full analysis

*Use one or several suitable statistical/machine learning methods to analyze your data and to produce meaningful figures, tables, etc. This might again be code that is best placed in one or several separate R scripts that need to be well documented. You want the code to produce figures and data ready for display as tables, and save those. Then you load them here.*

Example table ?? shows a table summarizing a linear model fit.

###{r resulttable, echo=FALSE} ###resulttable=readRDS("../../results/resulttable.rds") ###knitr::kable(resulttable, caption = 'Linear model fit table.') #

# 4 Discussion

## 4.1 Summary and Interpretation

*Summarize what you did, what you found and what it means.*

## 4.2 Strengths and Limitations

*Discuss what you perceive as strengths and limitations of your analysis.*

## 4.3 Conclusions

*What are the main take-home messages?*

*Include citations in your Rmd file using bibtex, the list of references will automatically be placed at the end*

This paper (Leek & Peng, 2015) discusses types of analyses.

Note that this cited reference will show up at the end of the document, the reference formatting is determined by the CSL file specified in the YAML header. Many more style files for almost any journal [are available](https://www.zotero.org/styles). You also specify the location of your bibtex reference file in the YAML. You can call your reference file anything you like, I just used the generic word references.bib but giving it a more descriptive name is probably better.

# References

Leek, J. T., & Peng, R. D. (2015). Statistics. What is the question? *Science (New York, N.Y.)*, *347*, 1314–1315. <https://doi.org/10.1126/science.aaa6146>