Econometrics 2 capstone final report data code

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Importing and cleaning data

Tables used for the progress report:

- Psychology (S10AI)
- Housing: water (S12AI)
- Household background information (S1D)
- Key household information (key_hhld_info)

In order to derive the following variables:

- Binary variable indicating mental health status (1 = likely to have a mental health disorder) (S10AI)
- Binary variable indicating access to basic drinking water services (1 = has access) (S1D)
- Age (S10AI)
- Binary variable indicating sex (1 = female) (S10AI)
- Binary variable indicating religious minority (1 = not Christian) (S1D)
- Binary variable indicating if the person lives in an urban or rural area (1 = in an urban area) (S1D)

Analysis in this markdown document is separated by each data table imported.

Importing the Pyschology table

```
#################################################################################
################################ PSYCHOLOGY TABLE ###############################
#################################################################################

s10ai <- read_csv("data/S10AI.csv") %>%
  select(hhno, hhmid, depression, sex = s1d_1, age = s1d_4i) %>%

  #Creating a new column as our depression_dummy. Kessler scores between 10-19 have a score o
f one in the data (== "likely to be well"). Anyone with scored higher than this has a score >
1, which classifies them as likely to have at least a mild disorder.
  mutate(depression_dummy = case_when(

    depression > 1 ~ 1, # Depressed
    TRUE ~ 0 # Not depressed

  )) %>%

  # Turning sex into a dummy variable (1 == female)

  mutate(sex = case_when(

    sex == 1 ~ 0,
    sex == 2 ~ 1

  ))


######################## EXTRACTING JUST THE RELEVANT VARIABLES ################

s10ai <- s10ai %>%
  select(hhno, hhmid, depression_dummy, sex_dummy = sex, age)
```

Importing the housing table

We are importing this table to create a dummy variable for access to basic drinking services.

UNICEF defines a household’s access to water as “basic” if it satisfies the following conditions:

- It’s delivered from one of the following sources: piped water, boreholes, tubewells, protected dug well, protected springs, rainwater and packaged of delivered water.
- A round trip to collect water does not exceed 30 minutes.

UNICEF actually has different definitions for water access, where we want to capture dummies for them as one of our extensions. They are defined as:

- Safely managed: Drinking water from an improved water souce which is located on premises, available when needed and free of faecal and priority contamination.
- Basic: as defined above.

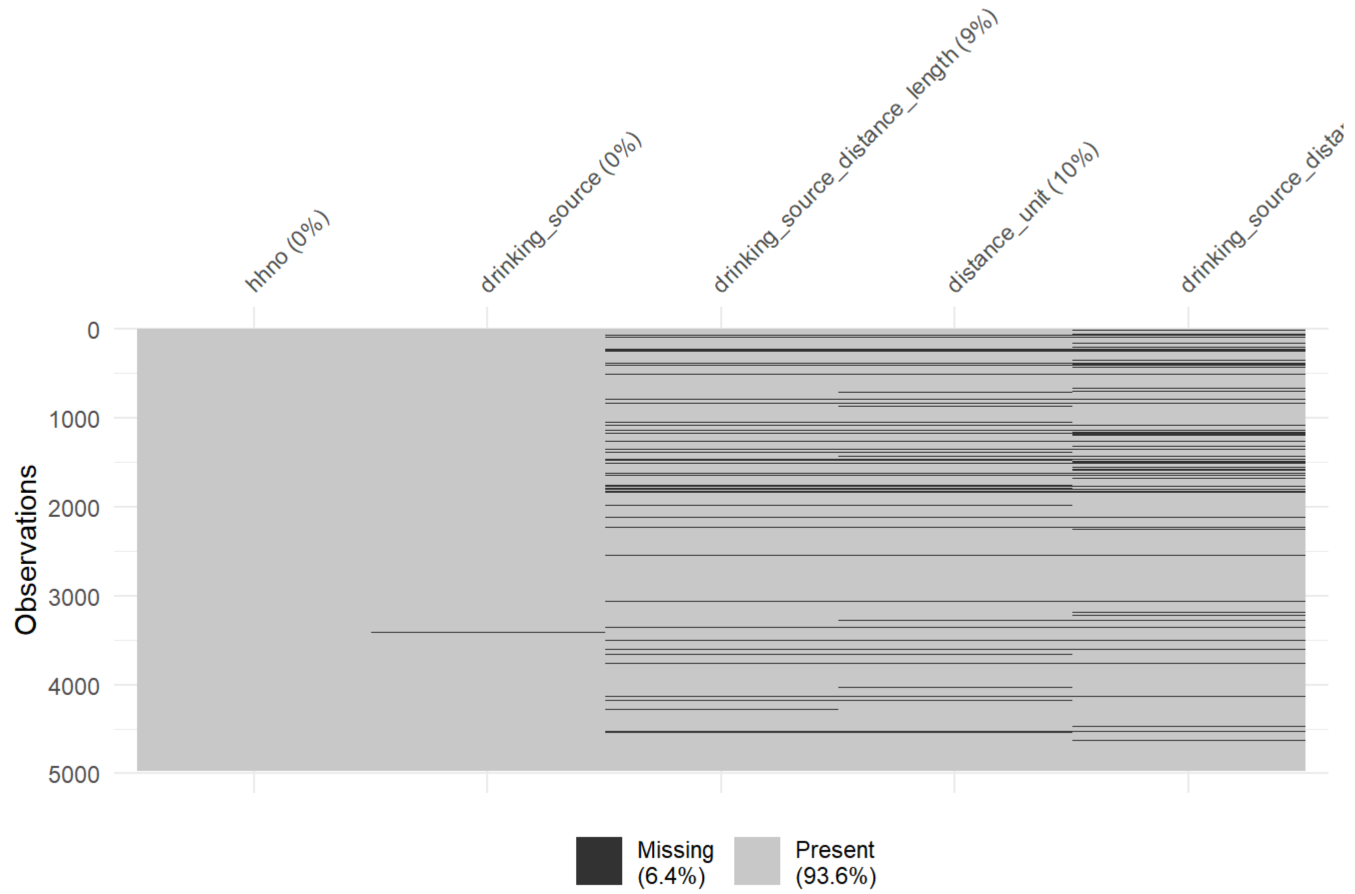
- No services: drinking water collected directly fro ma river, dam, lake, pond, stream, canal or irrigation channel.

```
################################################################################
############################### HOUSING TABLES #################################
################################################################################

############################### WATER TABLE ####################################








s12ai <- read_csv("data/S12AI.csv") %>%
  select(hhno,drinking_source = s12a_9i, drinking_source_distance_length = s12a_10ai, distanc
e_unit = s12a_10aii, drinking_source_distance_mins = s12a_11) %>%

  #Editing the drinking_source_distance cells to make them all the same scale: kilometres.

  mutate(drinking_source_distance_length = case_when(

    distance_unit == 0 ~ 0,  # In house
    distance_unit == 1 ~ as.numeric(drinking_source_distance_length) * 0.0009144,  # Yards to
kilometers
    distance_unit == 2 ~ as.numeric(drinking_source_distance_length) / 1000,  # Meters to kil
ometers
    distance_unit == 3 ~ as.numeric(drinking_source_distance_length),  # Already in kilometer
s
    distance_unit == 4 ~ as.numeric(drinking_source_distance_length) * 1.609344,  # Miles to
kilometers
    TRUE ~ drinking_source_distance_length

  ))
```

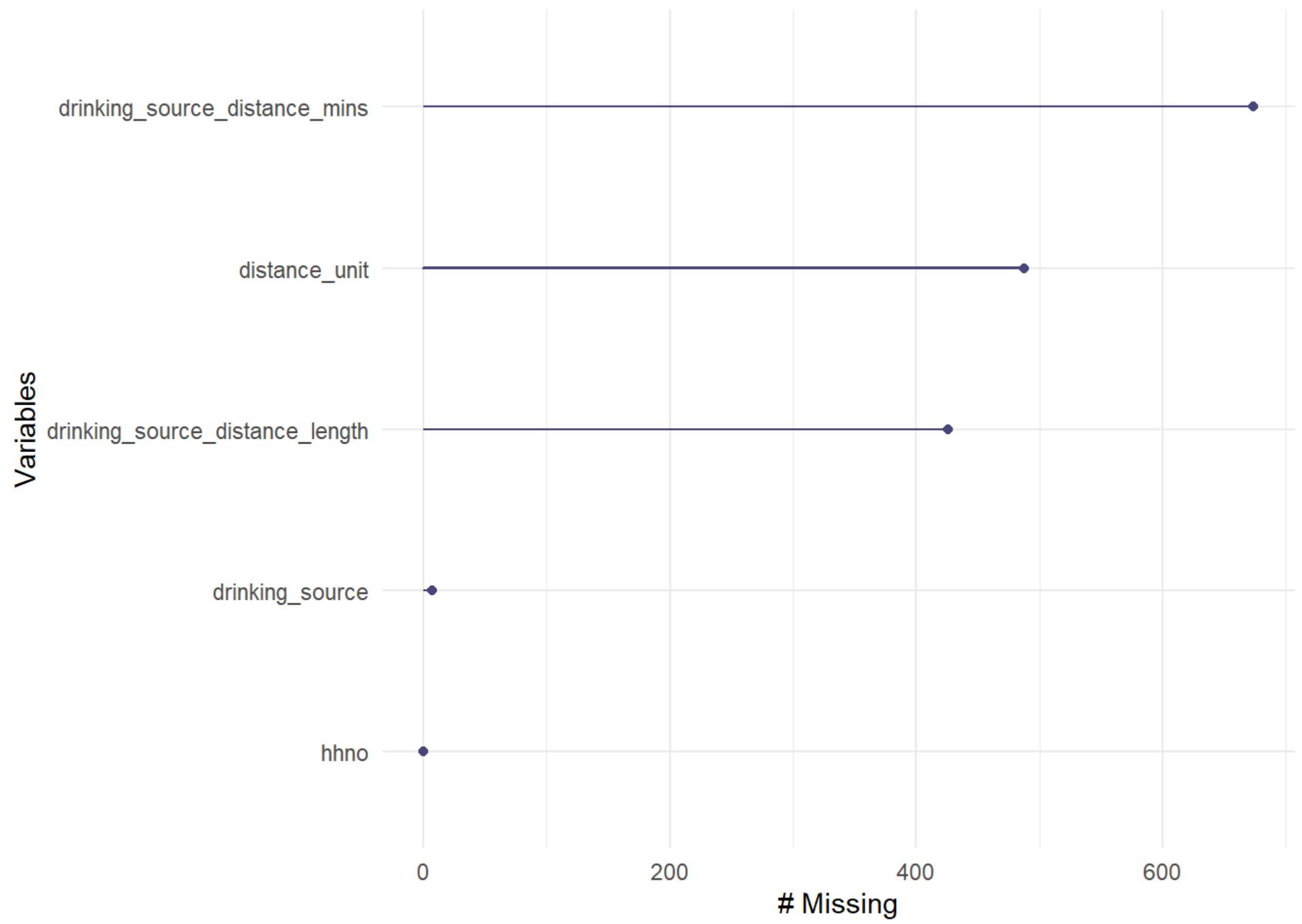
```
## Warning: One or more parsing issues, call `problems()` on your data frame for details,
## e.g.:
##   dat <- vroom(...)
##   problems(dat)
```

```
## Rows: 4972 Columns: 72
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## chr  (2): s12a_15, s12a_15i
## dbl (67): id1, id3, id4, id2, s12a_1, s12a_2i, s12a_2ii, s12a_2iii, s12a_3, ...
## lgl  (3): s12a_4i, s12a_4ii, s12a_4iii
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
vis_miss(s12ai)
```




```
gg_miss_var(s12ai)
```



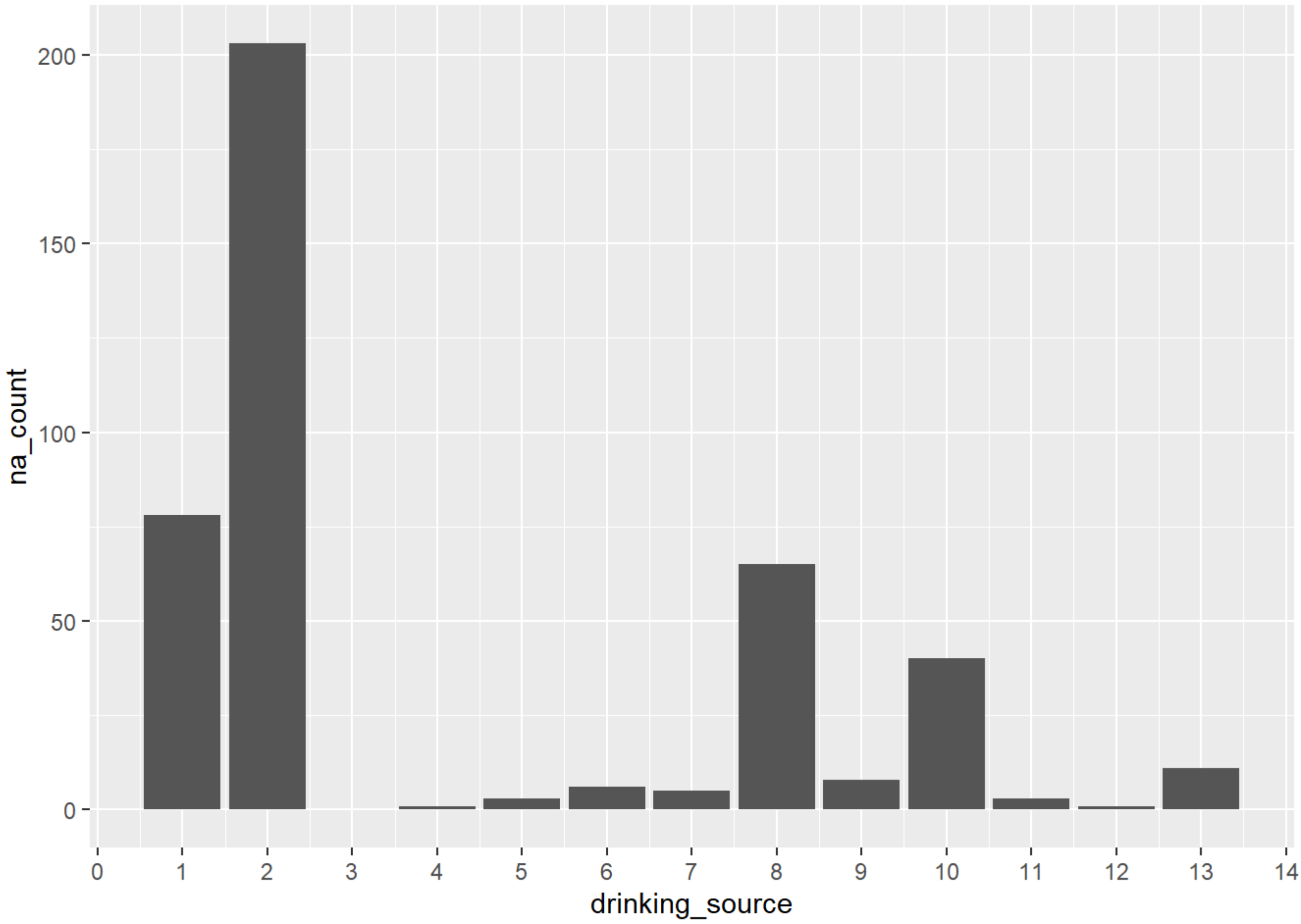
The charts above shows us that there is a lot of missing values for the distance variables in both length and mins. This likely have something todo with the drinking source of each household. I need to collect all the NA data together in order to diagnose the problem.

The charts below show us that:

- Most of the problem is in 1 and 2, which correspond to plumbing in the house. We can change their distances to zero.
- 8 is also a clear problem, which is bottled water. We think its reasonable to assume this botteld water is available at the house, so can change this distance to zero as well.
- 9 and 10 are protected wells and boreholes. Without more information about how far away they are (unavailable) we need to leave these as NAs.

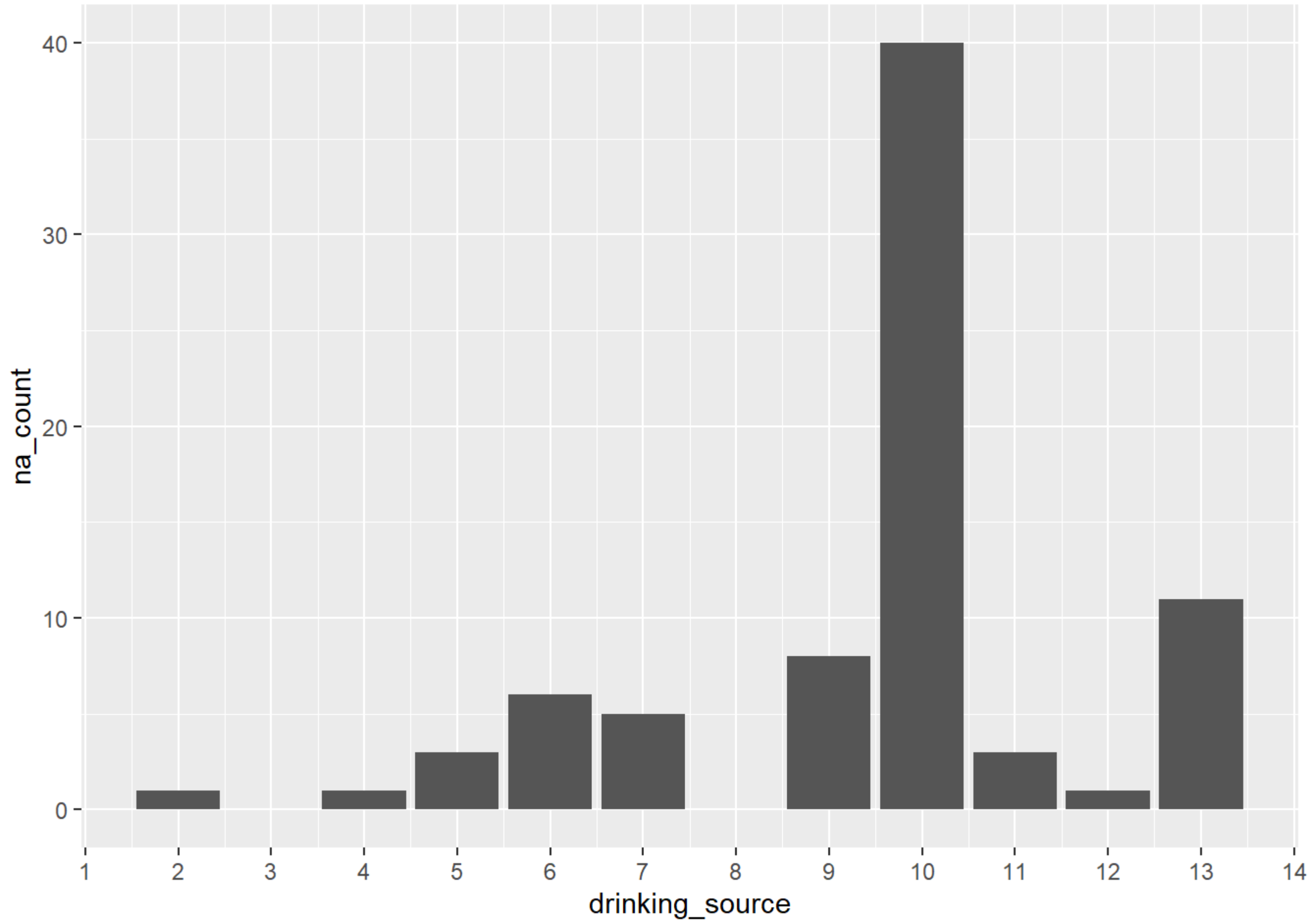
```
# Extracting and charting NA data

na_data <- s12ai %>%
  filter(is.na(drinking_source_distance_length)) %>%
  group_by(drinking_source) %>%
  summarise(na_count = n())

ggplot(na_data, aes(x = drinking_source, y = na_count)) +
  geom_bar(stat = "identity") +
  scale_x_continuous(breaks = scales::pretty_breaks(n = 14))
```

```
## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_bar()`).
```

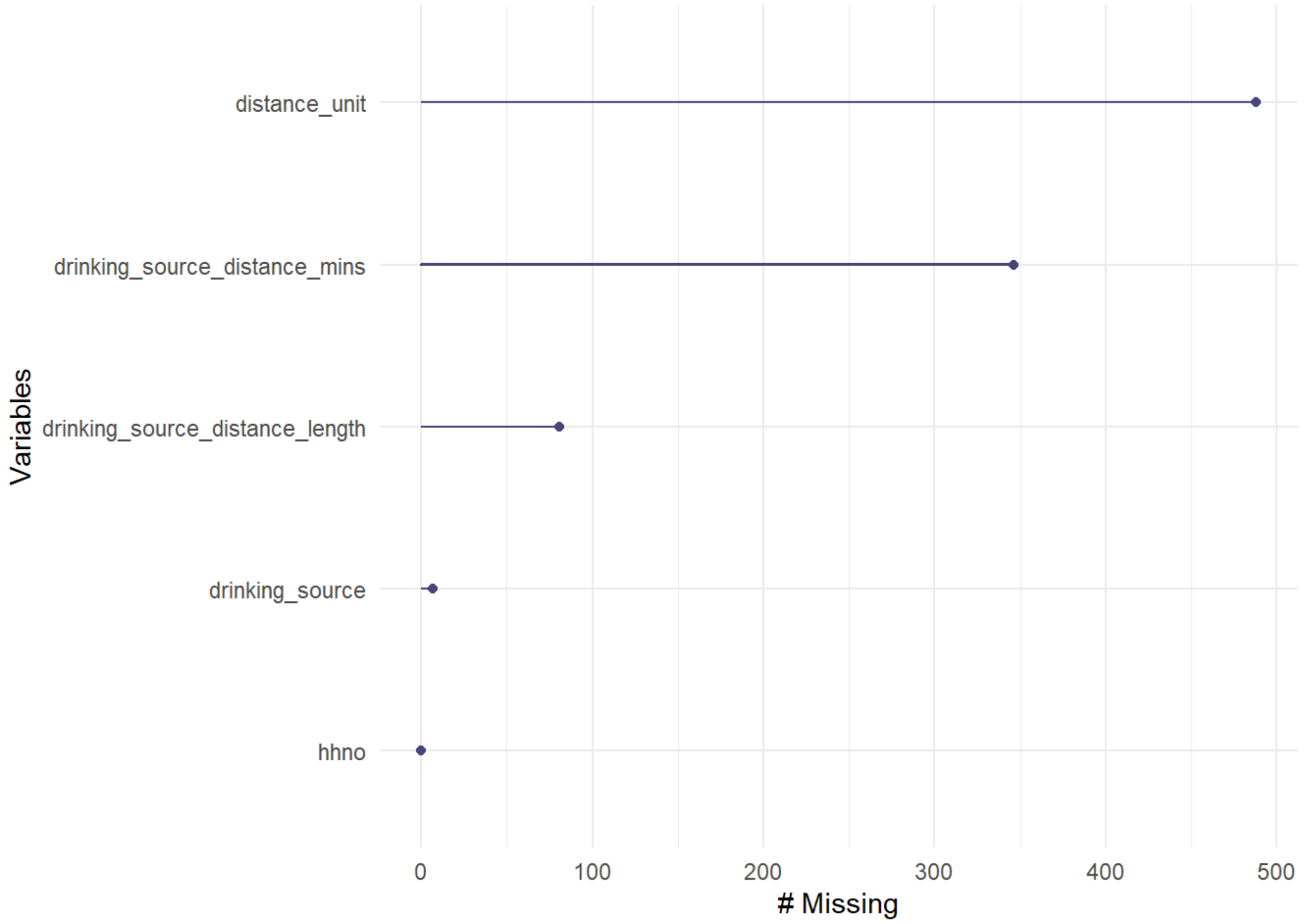


```
# Now I have diagnosed the problem, I need to make the necessary changes to the dataframe suc
h that dirnking_sources with values 1 and 2 have a distance of zero in both length and minute
s. All other NAs remain given data limitations.

s12ai <- s12ai %>%
  mutate(drinking_source_distance_length = case_when(

    is.na(distance_unit) & drinking_source %in% c(1, 2, 8) ~ 0,
    TRUE ~ drinking_source_distance_length
  )) %>%

  mutate(drinking_source_distance_mins = case_when(
        is.na(distance_unit) & drinking_source %in% c(1, 2, 8) ~ 0,
    TRUE ~ drinking_source_distance_mins
  ))



# Repeating the NA value analysis/chart below, the scale are now sufficiently small to contin
ue/we don't have any other information that could help reduce the incidence of NAs.

na_data <- s12ai %>%
  filter(is.na(drinking_source_distance_length)) %>%
  group_by(drinking_source) %>%
  summarise(na_count = n())

ggplot(na_data, aes(x = drinking_source, y = na_count)) +
  geom_bar(stat = "identity") +
  scale_x_continuous(breaks = scales::pretty_breaks(n = 14))
```

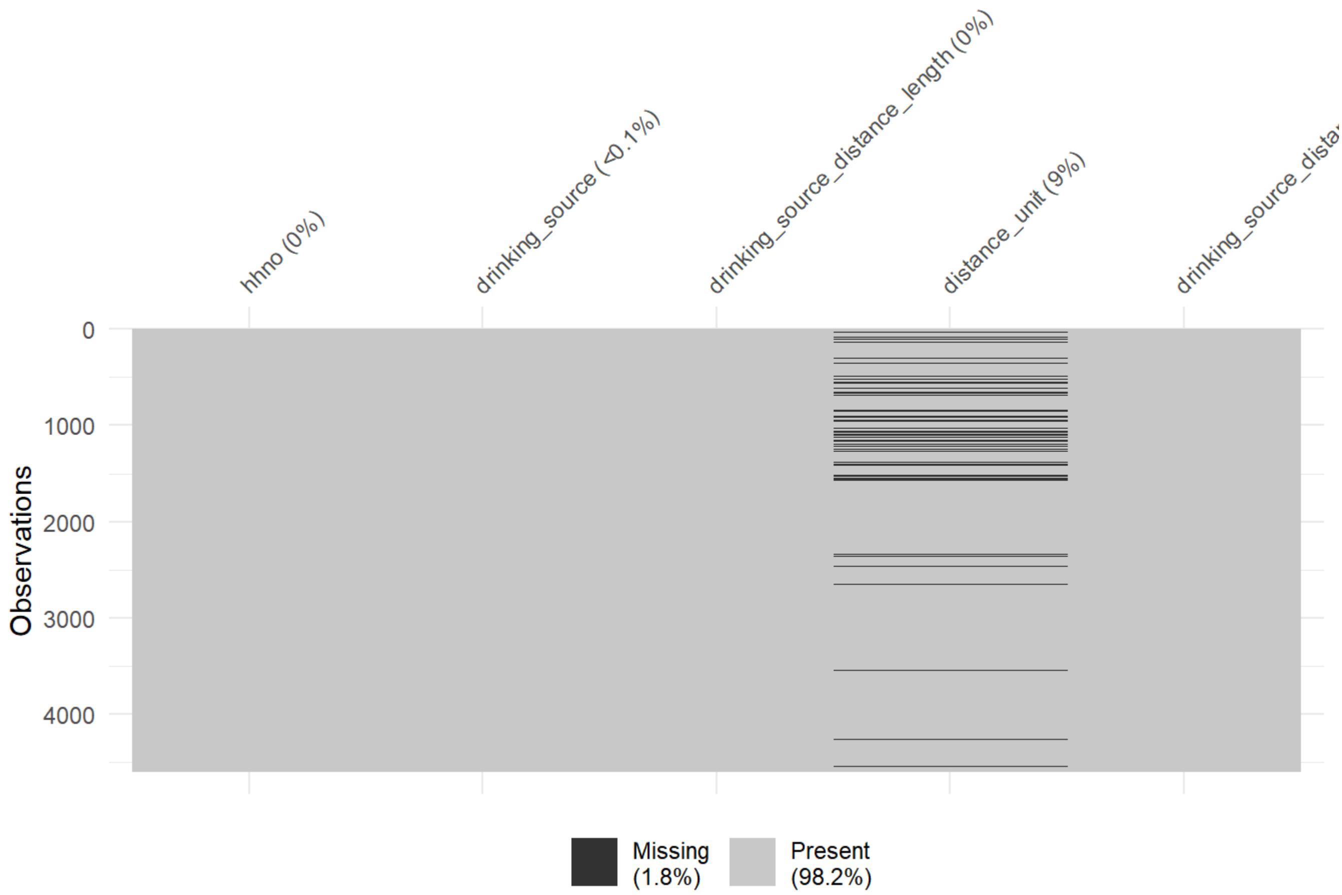
```
## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_bar()`).
```




```
gg_miss_var(s12ai)
```



```
# Because we can't deal with the remaining NAs, we exclude them from our analysis. However, w
e only exclude where NAs appear in the drinking_source_distance_length and drinking_source_di
stance_mins  variables.

s12ai <- s12ai %>%
  filter(!is.na(drinking_source_distance_length)) %>%
  filter(!is.na(drinking_source_distance_mins))

vis_miss(s12ai)
```



Now we can actually produce our dummy variable for access to “basic drinking services”.

```
s12ai <- s12ai %>%

  # Basic access

  mutate(

    basic_access_dummy = case_when(

      drinking_source_distance_mins <= 30 &
      drinking_source %in% c(1, # Indoor plumbing
                             2, # Inside standpipe
                             5, # Pipe in niehgbouring household
                             6, # Private outside standpipe/tap
                             7, # Public standpipe
                             8, # Sachet/bottled water
                             9, # Borehole
                             10) # Protected well
    ~ 1,
    TRUE ~ 0
  )) %>%

  # Safely managed

  mutate(

    safely_managed_dummy = case_when(

          drinking_source_distance_mins <= 2 &
          drinking_source %in% c(1, # Indoor plumbing
                             2, # Inside standpipe
                             5, # Pipe in niehgbouring household
                             6, # Private outside standpipe/tap
                             7, # Public standpipe
                             8, # Sachet/bottled water
                             9, # Borehole
                             10) # Protected well
        ~ 1,
        TRUE ~ 0
          )) %>%

  # No service

  mutate(no_service_dummy = case_when(

    drinking_source %in% c(12, # River/Stream
                           14) #Dugout/ponk/lake/dam

          ~ 1,
      TRUE ~ 0
  ))
```

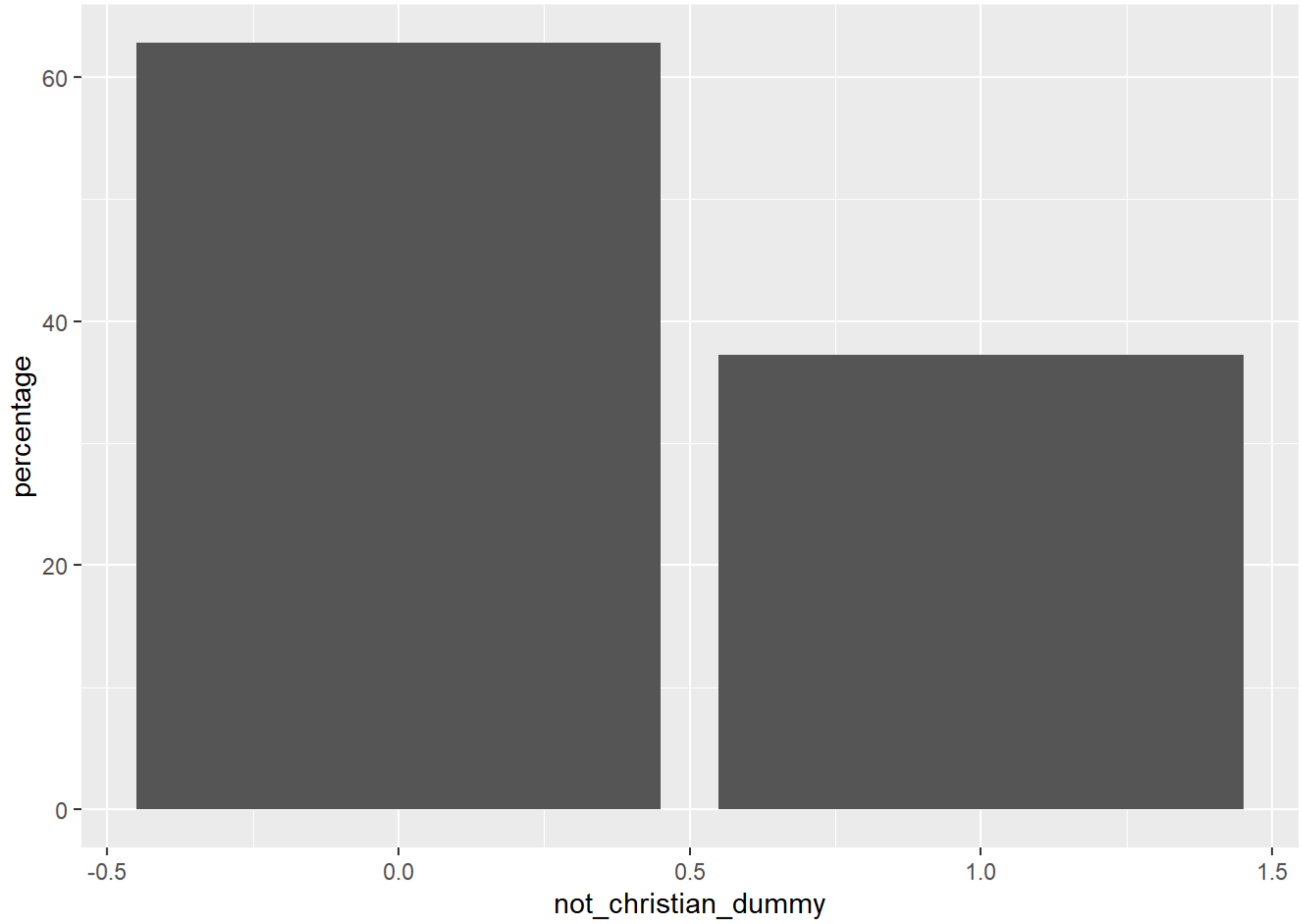
Importing the hosehold background information table

```
######################### RELIGIOUS MINORITY DUMMY ##############################


s1d <- read_csv("data/S1D.csv") %>%
  select(hhno, hhmid, religion = s1d_13, ethnicity = s1d_16) %>%
  mutate(not_christian_dummy = 0) %>%
  mutate(not_christian_dummy = case_when(

    # The following values of religion correspond with Christianity: 1,2,3,4,5 and 7.

    religion %in% c(1,2,3,4,5,7) ~ 0,
    TRUE ~ 1

  ))
```

```
## Warning: One or more parsing issues, call `problems()` on your data frame for details,
## e.g.:
##   dat <- vroom(...)
##   problems(dat)
```

```
## Rows: 18889 Columns: 48
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## dbl (46): id1, id2, id3, id4, hhmid, s1d_1, s1d_2, sid_3i, s1d_3ii, s1d_3iii...
## lgl  (2): s1d_28, s1d_33
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
# Is it reasonable to think of Christian as the relgious majority? The chart below suggest th
ey account for ~ 60% of the population. Therefore, it's reasonable to account for non-Christi
ans are part of the relgious minority in Ghana.

religion_dummy_frequency <- s1d %>%
  group_by(not_christian_dummy) %>%
    summarise(count = n()) %>%
  mutate(percentage = (count / sum(count)) * 100)



ggplot(religion_dummy_frequency, aes(not_christian_dummy, percentage)) + geom_bar(stat = "ide
ntity")
```




```
######################## EXTRACTING JUST THE RELEVANT VARIABLES ################

s1d <- s1d %>%
  select(hhno, hhmid, not_christian_dummy)
```

Importing key household information

```
key_hhld_info <- read_csv("data/key_hhld_info.csv") %>%
  select(hhno, rural_dummy = urbrur) %>%
  mutate(rural_dummy = case_when(

    rural_dummy == "1" ~ 0,
    TRUE ~ 1

  ))
```

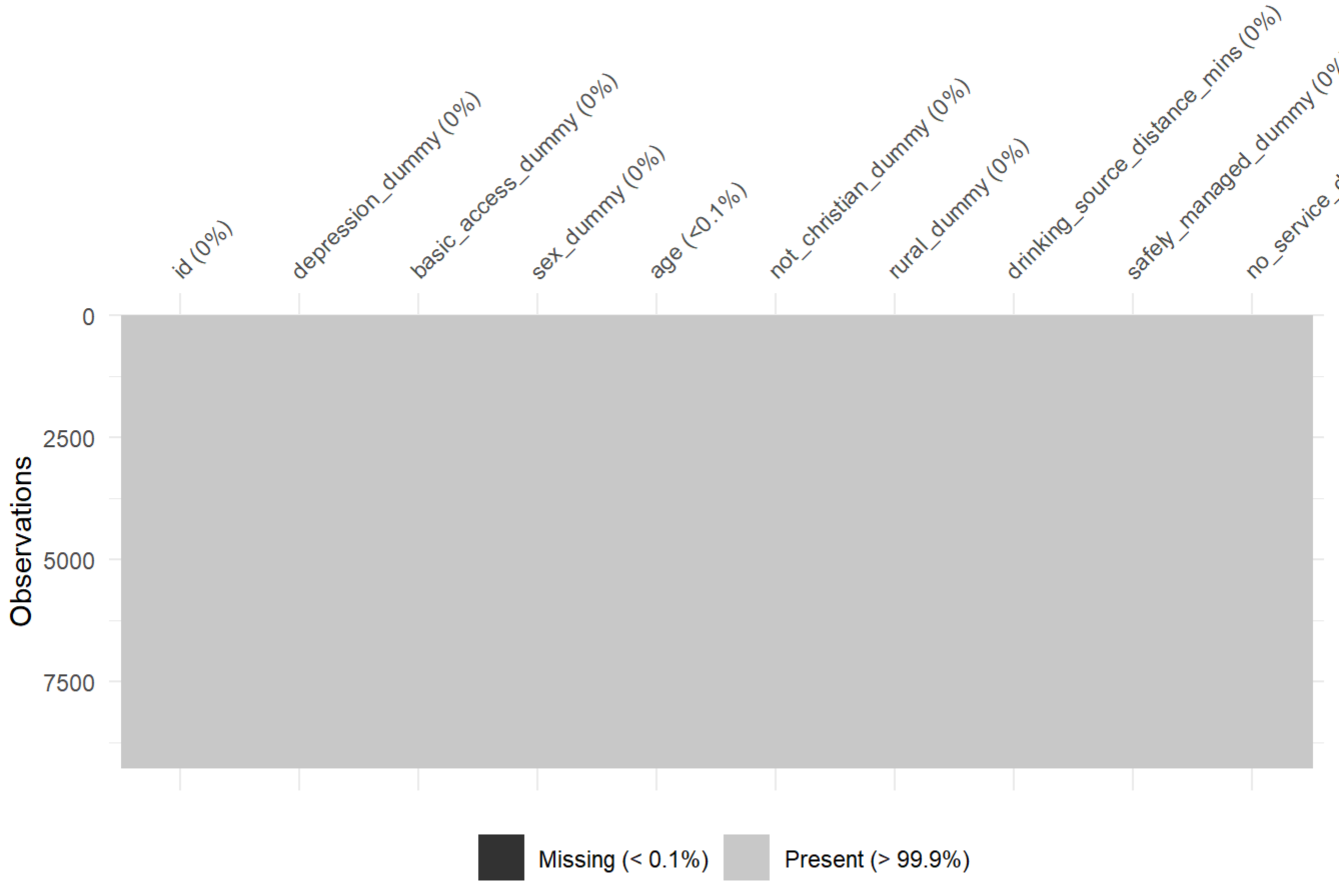
```
## Rows: 5009 Columns: 9
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## dbl (9): id1, id2, id3, id4, hhno, urbrur, loc7, hhweight3, ppweight3
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

Joining data

Household data is not provided at the individual level. Therefore, we need to append it to our psychological data.

Doing a quick NA visualisation I can see that there are a few columns with NA values. Given how small they are as proportions, I omit the NA values for depression and drinking_source_distance. I don't both with distance_unit (its only use was to help us clean the data earlier.)

```
data <- s10ai %>%
  inner_join(s12ai, by = "hhno") %>%
  inner_join(key_hhld_info, by = "hhno") %>%
  inner_join(s1d, by = c("hhno", "hhmid")) %>%  # This data is collected on the individual, t
herefore we need to join at the sub-household level.

  mutate(id = hhno + hhmid) %>%  # Creating a single hh identifier column

  select(id, depression_dummy, basic_access_dummy, sex_dummy, age, not_christian_dummy, rural
_dummy, drinking_source_distance_mins, safely_managed_dummy, no_service_dummy) #getting data
columns into a helpful order

vis_miss(data)
```




```
# Omitting the very few remaining NA values

data <- data %>%
  na.omit()
```

Creating summary statistics

```
vars <- colnames(data)[!colnames(data) %in% c("id")]

# Create summary statistics
summary_stats <- data %>%
  summarise(across(all_of(vars),
                   list(
                     mean = ~ mean(.x, na.rm = TRUE),
                     sd = ~ sd(.x, na.rm = TRUE),
                     min = ~ min(.x, na.rm = TRUE),
                     max = ~ max(.x, na.rm = TRUE)
                   ),
                   .names = "{.col}_{.fn}"))

# Reshape to long format
summary_stats <- summary_stats %>%
  pivot_longer(cols = everything(),
               names_to = c("variable", "statistic"),
               names_pattern = "(.*)_(.*)") %>%   # Match everything before the last undersco
re
  mutate(value = round(value,2))


summary_stats <- summary_stats %>%
  pivot_wider(names_from = statistic, values_from = value)

summary_stats$max <- format(summary_stats$max, scientific = FALSE)


print(summary_stats)
```

```
## # A tibble: 9 × 5
##   variable                       mean    sd   min max
##   <chr>                         <dbl> <dbl> <dbl> <chr>
## 1 depression_dummy               0.31  0.46     0 "  1"
## 2 basic_access_dummy             0.76  0.43     0 "  1"
## 3 sex_dummy                      0.55  0.5      0 "  1"
## 4 age                           39.1  18.7      1 "109"
## 5 not_christian_dummy            0.34  0.47     0 "  1"
## 6 rural_dummy                    0.65  0.48     0 "  1"
## 7 drinking_source_distance_mins 15.6  18.0      0 "240"
## 8 safely_managed_dummy           0.12  0.33     0 "  1"
## 9 no_service_dummy               0.15  0.35     0 "  1"
```

```
#################################### SAVING OFF DATA ###########################

write_csv(summary_stats, "summary_stats.csv")

write_csv(data, "model_data.csv")
```

Producing model outputs

```
data <- read_csv("model_data.csv")
```

```
## Rows: 9282 Columns: 10
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## dbl (10): id, depression_dummy, basic_access_dummy, sex_dummy, age, not_chri...
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

Key models/output

```
#################################### MODELS ####################################

# linear regression model
m1 <- lm(depression_dummy ~ basic_access_dummy, data = data)



# Multiple linear regresion model
m2 <- lm(depression_dummy ~ basic_access_dummy + sex_dummy + age + not_christian_dummy + rura
l_dummy, data = data)



# First stage 2SLS model
m3 <- lm(basic_access_dummy ~ drinking_source_distance_mins + sex_dummy + age + not_christian
_dummy + rural_dummy,
                  data = data)

# Second stage 2SLS model
m4 <- ivreg(depression_dummy ~ basic_access_dummy + sex_dummy + age + not_christian_dummy + r
ural_dummy |
      sex_dummy + age + not_christian_dummy + rural_dummy + drinking_source_distance_mins, da
ta = data)

summary(m4, vcov=vcovHC, diagnostics = TRUE)
```

```
##
## Call:
## ivreg(formula = depression_dummy ~ basic_access_dummy + sex_dummy +
##     age + not_christian_dummy + rural_dummy | sex_dummy + age +
##     not_christian_dummy + rural_dummy + drinking_source_distance_mins,
##     data = data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.7651 -0.3145 -0.1899  0.4967  0.9777
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          0.2200668  0.0294799   7.465 9.08e-14 ***
## basic_access_dummy  -0.2208962  0.0280809  -7.866 4.06e-15 ***
## sex_dummy            0.0861642  0.0093199   9.245  < 2e-16 ***
## age                  0.0038505  0.0002521  15.273  < 2e-16 ***
## not_christian_dummy  0.0833770  0.0108167   7.708 1.41e-14 ***
## rural_dummy          0.0443765  0.0115649   3.837 0.000125 ***
##
## Diagnostic tests:
##                  df1  df2 statistic  p-value
## Weak instruments    1 9276    354.29  < 2e-16 ***
## Wu-Hausman          1 9275     30.37 3.67e-08 ***
## Sargan              0   NA        NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4494 on 9276 degrees of freedom
## Multiple R-Squared: 0.05307, Adjusted R-squared: 0.05256
## Wald test: 133.4 on 5 and 9276 DF,  p-value: < 2.2e-16
```

Formatting output

```
#################################### OUTPUT TABLES ##############################



key_results <- stargazer(m1,
                         m2,
                         m3,
                         m4,
                         type = "html",
                         title = "Table 2: Model estimates",
                           se = list(
                          sqrt(diag(vcovHC(m1))),
                          sqrt(diag(vcovHC(m2))),
                          sqrt(diag(vcovHC(m3))),
                          sqrt(diag(vcovHC(m4)))
                          ),
                        out = "Key_Results.html"

  )
```

```
##
## <table style="text-align:center"><caption><strong>Table 2: Model estimates</strong></capti
on>
## <tr><td colspan="5" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-a
lign:left"></td><td colspan="4"><em>Dependent variable:</em></td></tr>
## <tr><td></td><td colspan="4" style="border-bottom: 1px solid black"></td></tr>
## <tr><td style="text-align:left"></td><td colspan="2">depression_dummy</td><td>basic_access
_dummy</td><td>depression_dummy</td></tr>
## <tr><td style="text-align:left"></td><td colspan="2"><em>OLS</em></td><td><em>OLS</em></td
><td><em>instrumental</em></td></tr>
## <tr><td style="text-align:left"></td><td colspan="2"><em></em></td><td><em></em></td><td><
em>variable</em></td></tr>
## <tr><td style="text-align:left"></td><td>(1)</td><td>(2)</td><td>(3)</td><td>(4)</td></tr>
## <tr><td colspan="5" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-a
lign:left">basic_access_dummy</td><td>-0.134<sup>***</sup></td><td>-0.093<sup>***</sup></td><
td></td><td>-0.221<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.012)</td><td>(0.012)</td><td></td><td>(0.028)
</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">drinking_source_distance_mins</td><td></td><td></td><td>-
0.010<sup>***</sup></td><td></td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td>(0.001)</td><td></td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">sex_dummy</td><td></td><td>0.086<sup>***</sup></td><td>0.0
07</td><td>0.086<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td></td><td>(0.009)</td><td>(0.008)</td><td>(0.009)
</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">age</td><td></td><td>0.004<sup>***</sup></td><td>-0.0002</
td><td>0.004<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td></td><td>(0.0002)</td><td>(0.0002)</td><td>(0.000
3)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">not_christian_dummy</td><td></td><td>0.099<sup>***</sup></
td><td>-0.039<sup>***</sup></td><td>0.083<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td></td><td>(0.010)</td><td>(0.009)</td><td>(0.011)
</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">rural_dummy</td><td></td><td>0.074<sup>***</sup></td><td>-
0.140<sup>***</sup></td><td>0.044<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td></td><td>(0.010)</td><td>(0.008)</td><td>(0.012)
</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">Constant</td><td>0.409<sup>***</sup></td><td>0.100<sup>***
</sup></td><td>1.031<sup>***</sup></td><td>0.220<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.010)</td><td>(0.017)</td><td>(0.011)</td><td>
(0.029)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td><td></td></tr>
## <tr><td colspan="5" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-a
lign:left">Observations</td><td>9,282</td><td>9,282</td><td>9,282</td><td>9,282</td></tr>
## <tr><td style="text-align:left">R<sup>2</sup></td><td>0.015</td><td>0.066</td><td>0.266</t
d><td>0.053</td></tr>
## <tr><td style="text-align:left">Adjusted R<sup>2</sup></td><td>0.015</td><td>0.065</td><td
>0.266</td><td>0.053</td></tr>
## <tr><td style="text-align:left">Residual Std. Error</td><td>0.458 (df = 9280)</td><td>0.44
```

```
6 (df = 9276)</td><td>0.367 (df = 9276)</td><td>0.449 (df = 9276)</td></tr>
## <tr><td style="text-align:left">F Statistic</td><td>145.179<sup>***</sup> (df = 1; 9280)</td><td>130.714<sup>***</sup> (df = 5; 9276)</td><td>672.072<sup>***</sup> (df = 5; 9276)</td><td></td></tr>
## <tr><td colspan="5" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left"><em>Note:</em></td><td colspan="4" style="text-align:right"><sup>*</sup>p<0.1; <sup>**</sup>p<0.05; <sup>***</sup>p<0.01</td></tr>
## </table>
```

```
key_results <- stargazer(m1,
                         m2,
                         m3,
                         m4,
                         type = "text",
                         title = "Table 2: Model estimates",
                           se = list(
                          sqrt(diag(vcovHC(m1))),
                          sqrt(diag(vcovHC(m2))),
                          sqrt(diag(vcovHC(m3))),
                          sqrt(diag(vcovHC(m4)))
                          )  )
```

```
##
## Table 2: Model estimates
## ============================================================================================
===================================
##                                                                         Dependent variable:
##                                  --------------------------------------------------------------
-----------------------------------
##                                                      depression_dummy                    basic
_access_dummy     depression_dummy
##                                                             OLS
OLS              instrumental
##
variable
##                                                (1)                        (2)
(3)                   (4)
## ---------------------------------------------------------------------------------------------
-----------------------------------
## basic_access_dummy                          -0.134***                  -0.093***
-0.221***
##                                             (0.012)                    (0.012)
(0.028)
##
## drinking_source_distance_mins
-0.010***
##
(0.001)
##
## sex_dummy                                                              0.086***
0.007               0.086***
##                                                                         (0.009)
(0.008)              (0.009)
##
## age                                                                    0.004***
-0.0002              0.004***
##                                                                        (0.0002)
(0.0002)             (0.0003)
##
## not_christian_dummy                                                    0.099***
-0.039***            0.083***
##                                                                         (0.010)
(0.009)              (0.011)
##
## rural_dummy                                                            0.074***
-0.140***            0.044***
##                                                                         (0.010)
(0.008)              (0.012)
##
## Constant                                    0.409***                   0.100***
1.031***             0.220***
##                                             (0.010)                    (0.017)
(0.011)              (0.029)
##
## ---------------------------------------------------------------------------------------------
-----------------------------------
## Observations                                 9,282                      9,282
```

```
9,282                 9,282
## R2                                     0.015                     0.066
0.266                 0.053
## Adjusted R2                            0.015                     0.065
0.266                 0.053
## Residual Std. Error              0.458 (df = 9280)         0.446 (df = 9276)         0.36
7 (df = 9276)     0.449 (df = 9276)
## F Statistic                  145.179*** (df = 1; 9280) 130.714*** (df = 5; 9276) 672.072*
** (df = 5; 9276)
## ==============================================================================================
===================================
## Note:
*p<0.1; **p<0.05; ***p<0.01
```

```
##################### AUTOMATING OUTPUTTING TABLES TO XLSX FILE ################

key_results_table <- read_html("Key_Results.html") %>%
    html_table(fill = TRUE) %>%
    pluck(1) %>%
    filter(if_any(c(X1, X2, X3), ~ . != ""))

write_xlsx(key_results_table, "key_results_table.xlsx")
```

Robustness checks

Changing definitions of water access

Ultimately, our chosen definition of water access has been chosen arbitrarily from UNICEF's taxonomy of access. If our results are robust, the size of our estimators should decrease as we move from the lowest ("no service") to highest ("safely managed") level of water access. The better the access, the greater an impact it should have on reducing the incidence of mental health issues.

```
################################### CREATING MODELS #############################


#No service
m5 <- ivreg(depression_dummy ~ no_service_dummy + sex_dummy + age + not_christian_dummy + rur
al_dummy |
      sex_dummy + age + not_christian_dummy + rural_dummy + drinking_source_distance_mins, da
ta = data)


# Basic access
m6 <- ivreg(depression_dummy ~ basic_access_dummy + sex_dummy + age + not_christian_dummy + r
ural_dummy |
      sex_dummy + age + not_christian_dummy + rural_dummy + drinking_source_distance_mins, da
ta = data)


# Safely managed
m7 <- ivreg(depression_dummy ~ safely_managed_dummy + sex_dummy + age + not_christian_dummy +
rural_dummy |
      sex_dummy + age + not_christian_dummy + rural_dummy + drinking_source_distance_mins, da
ta = data)



################################## COMPARING OUTPUT ##############################

rc_water_def_results <- stargazer(
          m5,
          m6,
          m7,
          type = "html",
          title = "Table X: Changing water definition estimates",
          se = list(
          sqrt(diag(vcovHC(m5))),
          sqrt(diag(vcovHC(m6))),
          sqrt(diag(vcovHC(m7)))
          ),
          out = "RC_Water_Def_Results.html"
          )
```

```
##
## <table style="text-align:center"><caption><strong>Table X: Changing water definition estimates</strong></caption>
## <tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left"></td><td colspan="3"><em>Dependent variable:</em></td></tr>
## <tr><td></td><td colspan="3" style="border-bottom: 1px solid black"></td></tr>
## <tr><td style="text-align:left"></td><td colspan="3">depression_dummy</td></tr>
## <tr><td style="text-align:left"></td><td>(1)</td><td>(2)</td><td>(3)</td></tr>
## <tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left">no_service_dummy</td><td>0.531<sup>***</sup></td><td></td><td></td></tr>
## <tr><td style="text-align:left"></td><td>(0.083)</td><td></td><td></td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">basic_access_dummy</td><td></td><td>-0.221<sup>***</sup></td><td></td></tr>
## <tr><td style="text-align:left"></td><td></td><td>(0.028)</td><td></td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">safely_managed_dummy</td><td></td><td></td><td>-0.537<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td>(0.073)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">sex_dummy</td><td>0.090<sup>***</sup></td><td>0.086<sup>***</sup></td><td>0.088<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.010)</td><td>(0.009)</td><td>(0.010)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">age</td><td>0.004<sup>***</sup></td><td>0.004<sup>***</sup></td><td>0.004<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.0003)</td><td>(0.0003)</td><td>(0.0003)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">not_christian_dummy</td><td>0.077<sup>***</sup></td><td>0.083<sup>***</sup></td><td>0.099<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.012)</td><td>(0.011)</td><td>(0.011)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">rural_dummy</td><td>-0.003</td><td>0.044<sup>***</sup></td><td>-0.041<sup>*</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.018)</td><td>(0.012)</td><td>(0.021)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td style="text-align:left">Constant</td><td>0.001</td><td>0.220<sup>***</sup></td><td>0.166<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.013)</td><td>(0.029)</td><td>(0.025)</td></tr>
## <tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
## <tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left">Observations</td><td>9,282</td><td>9,282</td><td>9,282</td></tr>
## <tr><td style="text-align:left">R<sup>2</sup></td><td>-0.068</td><td>0.053</td><td>-0.015</td></tr>
## <tr><td style="text-align:left">Adjusted R<sup>2</sup></td><td>-0.069</td><td>0.053</td><td>-0.016</td></tr>
## <tr><td style="text-align:left">Residual Std. Error (df = 9276)</td><td>0.477</td><td>0.449</td><td>0.465</td></tr>
## <tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left"><em>Note:</em></td><td colspan="3" style="text-align:right"><sup>*</sup>p<0.1; <sup>**</sup>p<0.05; <sup>***</sup>p<0.01</td></tr>
## </table>
```

```
rc_water_def_results <- stargazer(
          m5,
          m6,
          m7,
          type = "text",
          title = "Table X: Changing water definition estimates",
          se = list(
          sqrt(diag(vcovHC(m5))),
          sqrt(diag(vcovHC(m6))),
          sqrt(diag(vcovHC(m7)))
          )          )
```

```
##
## Table X: Changing water definition estimates
## ================================================================
##                                        Dependent variable:
##                                   -----------------------------
##                                          depression_dummy
##                                      (1)       (2)       (3)
## ----------------------------------------------------------------
## no_service_dummy                  0.531***
##                                    (0.083)
##
## basic_access_dummy                          -0.221***
##                                              (0.028)
##
## safely_managed_dummy                                  -0.537***
##                                                        (0.073)
##
## sex_dummy                         0.090***  0.086***  0.088***
##                                    (0.010)   (0.009)   (0.010)
##
## age                               0.004***  0.004***  0.004***
##                                   (0.0003)  (0.0003)  (0.0003)
##
## not_christian_dummy               0.077***  0.083***  0.099***
##                                    (0.012)   (0.011)   (0.011)
##
## rural_dummy                        -0.003   0.044***   -0.041*
##                                    (0.018)   (0.012)   (0.021)
##
## Constant                            0.001   0.220***  0.166***
##                                    (0.013)   (0.029)   (0.025)
##
## ----------------------------------------------------------------
## Observations                        9,282     9,282     9,282
## R2                                 -0.068     0.053    -0.015
## Adjusted R2                        -0.069     0.053    -0.016
## Residual Std. Error (df = 9276)     0.477     0.449     0.465
## ================================================================
## Note:                               *p<0.1; **p<0.05; ***p<0.01
```

```
#################### AUTOMATING OUTPUTTING TABLES TO XLSX FILE ###############

rc_water_def_results_table <- read_html("RC_Water_Def_Results.html") %>%
    html_table(fill = TRUE) %>%
    pluck(1) %>%
    filter(if_any(c(X1, X2, X3, X4), ~ . != ""))

write_xlsx(rc_water_def_results_table, "rc_water_def_results_table.xlsx")

print
```

```
## function (x, ...)
## UseMethod("print")
## <bytecode: 0x000001ca1f53e4a8>
## <environment: namespace:base>
```

```
#################### AUTOMATING OUTPUTTING TABLES TO XLSX FILE ###############

key_results_table <- read_html("Key_Results.html") %>%
    html_table(fill = TRUE) %>%
    pluck(1) %>%
    filter(if_any(c(X1, X2, X3), ~ . != ""))

write_xlsx(key_results_table, "key_results_table.xlsx")
```