Comparing Influenza vaccination rates before and after the H1N1 pandemic

```
library(tidyverse)
```

```
## -- Attaching packages -----------------------------------------------------------------------------

## v ggplot2 3.3.0     v purrr   0.3.3
## v tibble  2.1.3     v dplyr   0.8.5
## v tidyr   1.0.2     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0

## -- Conflicts -----------------------------------------------------------------------------------------
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(xlsx)
library(readxl)
```

Given the COVID-19 outbreak in the spring of 2020, I became interested to compare child and teenager vaccination rates from the years surrounding the 2009 H1N1 pandemic to see if the pandemic led to an increased rate of influenza vaccinations. I took vaccination data from the National Institute of Health database two years prior to the pandemic (2007-8) the year of the pandemic (2009), and two years following the pandemic (2010-11).

```
PUF <- file.path()

flatfile <- file.path("/cloud/project/NISPUF11.DAT")

AGEGRPlevels=c(1,2,3)
AGEGRPnamess=c("19 - 23 MONTHS", "24 - 29 MONTHS", "30 - 35 MONTHS")

LANGUAGElevels=c(1,2,3)
LANGUAGEnamess=c("ENGLISH", "SPANISH", "OTHER")

YNDKRFlevels=c(1,2,77,99)
YNDKRFnamess=c("YES", "NO", "DON'T KNOW", "REFUSED")

SHOTCOUNlevels=c(77,88,99)
SHOTCOUNnamess=c("DON'T KNOW", "1+ BUT UNKNOWN NUMBER", "REFUSED")

SCUTDlevels=c(1,2,77,88,99)
SCUTDnamess=c("UTD / SC", "NOT UTD / SC", "DON'T KNOW", "UNKNOWN", "REFUSED")

HHNUMlevels=c(0,1,50,77,99)
HHNUMnamess=c("NONE", "AT LEAST ONE", "ALL", "DON'T KNOW", "REFUSED")

YNlevels=c(1,2)
YNnamess=c("YES", "NO")
```

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SHOTCARDlevels=c(1,2)
SHOTCARDnamess=c("SHOTCARD", "NO SHOTCARD")

Ylevels=c(1)
Ynamess=c("YES")

CHILDNMlevels=c(1,2,3,77,99)
CHILDNMnamess=c("ONE", "TWO OR THREE", "FOUR OR MORE", "DON'T KNOW", "REFUSED")

CWIClevels=c(1,2,3,77,99)
CWICnamess=c("YES", "NO", "NEVER HEARD OF WIC", "DON'T KNOW", "REFUSED")

EDUC1_levels=c(1,2,3,4,77,99)
EDUC1_namess=c("< 12 YEARS", "12 YEARS", "> 12 YEARS, NON-COLLEGE GRAD", "COLLEGE GRAD", "DON'T KNOW",

HISPlevels=c(1,2,3,4,5)
HISPnamess=c("HISPANIC", "NON-HISPANIC", "OTHER", "DON'T KNOW", "REFUSED")

MAGEGRPlevels=c(1,2,3,77,99)
MAGEGRPnamess=c("<= 19 YEARS", "20 - 29 YEARS", ">= 30 YEARS", "DON'T KNOW", "REFUSED")

MOBILlevels=c(1,2,77,99)
MOBILnamess=c("MOVED FROM DIFFERENT STATE", "DID NOT MOVE FROM DIFFERENT STATE", "DON'T KNOW", "REFUSED

SEXlevels=c(1,2,77,99)
SEXnamess=c("MALE", "FEMALE", "DON'T KNOW", "REFUSED")

INCPOVlevels=c(1,2,3,4)
INCPOVnamess=c("ABOVE POVERTY, > $75K", "ABOVE POVERTY, <= $75K", "BELOW POVERTY", "UNKNOWN")

DISPlevels=c(1,10,11,2,3,4,5,6,7,8,9)
DISPnamess=c("COMPLETE PROVIDER INFO, NO PROBLEMS", "INCOMPLETE PROVIDER RESP, HH NOT EXACT", "INCOMPLE
             "COMPLETE PROVIDER INFO, POOR HIST/OTHER", "INCOMPLETE PROVIDER RESP, BUT 4:3:1:3:3 INDICA
             "INCOMPLETE PROVIDER RESP, MATCHES HH")

HASPDA2Flevels=c(1,2)
HASPDA2Fnamess=c("CHILD HAS ADEQUATE PROVIDER DATA OR ZERO VACCINATIONS", "CHILD DOES NOT HAVE ADEQUATE

PROVIDlevels=c(1,2,3,4,5,6,7)
PROVIDnamess=c("ALL PUBLIC FACILITIES", "ALL HOSPITAL FACILITIES", "ALL PRIVATE FACILITIES", "ALL MILIT

REGISTRYlevels=c(1,2,3,4)
REGISTRYnamess=c("ALL PROVIDERS", "SOME BUT POSSIBLY OR DEFINITELY NOT ALL PROVIDERS", "NO PROVIDERS",

TYPElevels=c("","01","02","03","04","05","07","08","1L","1M","1N","20","21","22","30","31","32","33","4
             "RM","RO","TY","UN","VA","VM","VO","YF")
TYPEnamess=c("MISSING", "DT", "DTP", "DTP-UNKNOWN", "DTAP", "DTP-HIB", "DTAP-HIB", "DTAP-HEPB-IPV", "H1
             "HEPB-HIB", "HIB ONLY-UNKNOWN", "HEPB ONLY", "PCV CONJUGATE-UNKNOWN", "PCV POLYSACCHARIDE"
             "SEASONAL FLU INJECTED", "FOUR-IN-ONE", "HIB (SANOFI OR GLAXOSMITHKLINE)", "HEPA", "HEPB-U
             "RUBELLA", "ROTARIX (GSK)", "ROTATEQ (MERCK)", "ROTAVIRUS-UNKNOWN", "TYPHOID", "UNCODABLE"

HEPBRTlevels=c(1,2)
HEPBRTnamess=c("AT LEAST ONE PROVIDER CHECKED GIVEN AT BIRTH", "NO PROVIDERS CHECKED GIVEN AT BIRTH")
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HEPFLGlevels=c(1,2)
HEPFLGnamess=c("HEPB BIRTH SHOT DATE IMPUTED FROM SHOTCARD", "HEPB BIRTH SHOT DATE IMPUTED FROM DISTRIBU

UTDlevels=c(0,1)
UTDnamess=c("NOT UTD", "UTD")

CENREGlevels=c(1,2,3,4)
CENREGnamess=c("NORTHEAST", "MIDWEST", "SOUTH", "WEST")

STATElevels=c(1,10,11,12,13,14,15,16,17,18,19,2,20,21,22,23,24,25,26,27,28,29,3,30,31,32,33,34,35,36,37
STATEnamess=c("ALABAMA", "DELAWARE", "DISTRICT OF COLUMBIA", "FLORIDA", "GEORGIA", "", "HAWAII", "IDAHO
              "MISSISSIPPI", "MISSOURI", "", "MONTANA", "NEBRASKA", "NEVADA", "NEW HAMPSHIRE", "NEW JERS
              "SOUTH DAKOTA", "TENNESSEE", "TEXAS", "UTAH", "ARKANSAS", "VERMONT", "VIRGINIA", "", "WASH

FLUUTDlevels=c(1,2,3)
FLUUTDnamess=c("VACCINATED", "NOT VACCINATED", "NOT ELIGIBLE")

RACE_PUFlevels=c(1,2,3)
RACE_PUFnamess=c("WHITE ONLY", "BLACK ONLY", "OTHER + MULTIPLE RACE")

AGECPOXRlevels=c(1,2,3,4)
AGECPOXRnamess=c("0 TO 6 MONTHS OLD", "7 TO 12 MONTHS OLD", "13 TO 18 MONTHS OLD", "19+ MONTHS OLD")

C1Rlevels=c(1,2,3,4,5,6,7,8)
C1Rnamess=c("1", "2", "3", "4", "5", "6", "7", "8+")

C5Rlevels=c(1,2,3,4,77,99)
C5Rnamess=c("MOTHER (STEP, FOSTER, ADOPTIVE) OR FEMALE GUARDIAN", "FATHER (STEP, FOSTER, ADOPTIVE) OR MA

INCQ298Alevels=c(10,11,12,13,14,3,4,5,6,7,77,8,9,99)
INCQ298Anamess=c("$35001 - $40000", "$40001 - $50000", "$50001 - $60000", "$60001 - $75000", "$75001+",

RACEETHKlevels=c(1,2,3,4)
RACEETHKnamess=c("HISPANIC", "NON-HISPANIC WHITE ONLY", "NON-HISPANIC BLACK ONLY", "NON-HISPANIC OTHER +

D6Rlevels=c(0,1,2,3)
D6Rnamess=c("0", "1", "2", "3+")

FRSTBRNlevels=c(1,2,77,99)
FRSTBRNnamess=c("NO", "YES", "DON'T KNOW", "REFUSED")

CHARIDlevels=c( )
CHARIDnamess=c("MISSING")

BFFORM08Flevels=c(888)
BFFORM08Fnamess=c("NEVER FED FORMULA")

RENTOWNlevels=c(1,2,3,77,99)
RENTOWNnamess=c("OWNED OR BEING BOUGHT", "RENTED", "OTHER ARRANGMENT", "DON'T KNOW", "REFUSED")

NUM_PHONlevels=c(1,2,3,4,77,99)
NUM_PHONnamess=c("ONE", "TWO", "THREE OR MORE", "NONE", "DON'T KNOW", "REFUSED")
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INS_STATlevels=c(1,2,3)
INS_STATnamess=c("YES", "NO", "NOT ASCERTAINED")

MAR_PUF2_levels=c(1,2)
MAR_PUF2_namess=c("MARRIED", "NEVER MARRIED/WIDOWED/DIVORCED/SEPARATED/DECEASED")

UTDPCVBlevels=c(1,2,3)
UTDPCVBnamess=c("4+ PCV7 PLUS 1+ PCV13", "4+ PCV7, NO FOLLOWING PCV13, WITH TYPE OF ALL VACCINES (IF AN

SAMPFRAMElevels=c(1,2)
SAMPFRAMEnamess=c("LANDLINE SAMPLE FRAME", "CELL-PHONE SAMPLE FRAME")

ESTIAP11Flevels=c(1,10,103,11,12,13,14,16,17,18,19,2,20,22,25,27,28,29,30,31,34,35,36,38,4,40,41,44,46,
ESTIAP11Fnamess=c("CT", "NY-REST OF STATE", "MD-PRINCE GEORGE'S COUNTY", "NY-CITY OF NEW YORK", "DC", "
                  "IL-REST OF STATE", "IL-CITY OF CHICAGO", "IN", "MI", "ME", "MN", "OH", "WI", "AR", "
                  "ND", "SD", "UT", "WY", "AZ", "CA", "VT", "HI", "NV", "AK", "ID", "OR", "WA", "NJ", "



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    "XFLUTY5",2,
    "XFLUTY6",2,
    "XFLUTY7",2,
    "XFLUTY8",2,
    "XFLUTY9",1,
    "XH1NTY1",2,
    "XH1NTY2",2,
    "XH1NTY3",2,
    "XH1NTY4",2,
    "XH1NTY5",2,
    "XH1NTY6",1,
    "XH1NTY7",1,
    "XH1NTY8",1,
    "XH1NTY9",1,
    "XHEPTY1",2,
    "XHEPTY2",2,
    "XHEPTY3",2,
    "XHEPTY4",2,
    "XHEPTY5",2,
    "XHEPTY6",2,
    "XHEPTY7",1,
    "XHEPTY8",1,
    "XHEPTY9",1,
    "XHIBTY1",2,
    "XHIBTY2",2,
    "XHIBTY3",2,
    "XHIBTY4",2,
```

```
    "XHIBTY5",2,
    "XHIBTY6",2,
    "XHIBTY7",2,
    "XHIBTY8",1,
    "XHIBTY9",1,
    "XMMRTY1",2,
    "XMMRTY2",2,
    "XMMRTY3",2,
    "XMMRTY4",1,
    "XMMRTY5",1,
    "XMMRTY6",1,
    "XMMRTY7",1,
    "XMMRTY8",1,
    "XMMRTY9",1,
    "XPCVTY1",2,
    "XPCVTY2",2,
    "XPCVTY3",2,
    "XPCVTY4",2,
    "XPCVTY5",2,
    "XPCVTY6",2,
    "XPCVTY7",2,
    "XPCVTY8",1,
    "XPCVTY9",1,
    "XPOLTY1",2,
    "XPOLTY2",2,
    "XPOLTY3",2,
    "XPOLTY4",2,
    "XPOLTY5",2,
    "XPOLTY6",2,
    "XPOLTY7",1,
    "XPOLTY8",1,
    "XPOLTY9",1,
    "XROTTY1",2,
    "XROTTY2",2,
    "XROTTY3",2,
    "XROTTY4",2,
    "XROTTY5",2,
    "XROTTY6",1,
    "XROTTY7",1,
    "XROTTY8",1,
    "XROTTY9",1,
    "XVRCTY1",2,
    "XVRCTY2",2,
    "XVRCTY3",2,
    "XVRCTY4",1,
    "XVRCTY5",1,
    "XVRCTY6",1,
    "XVRCTY7",1,
    "XVRCTY8",1,
    "XVRCTY9",1,
    "INS_1",2,
    "INS_2",2,
    "INS_3",2,
```

```
    "INS_3A",2,
    "INS_4_5",2,
    "INS_6",2,
    "INS_11",2,
    "VFC_I",1
  )

NAMEWIDTH <- matrix(LIST.NAMEWIDTH, 515, 2, byrow=T, dimnames = list(NULL, c("VARIABLE","WIDTH")))
NA_STRING <- c(" ", ".", " .", "  .", "   .", "   .    ", " .              ", "    .              ", "

NISPUF11 <- read.fwf(flatfile, widths= as.numeric(NAMEWIDTH[,2]), col.names = NAMEWIDTH[,1], na.strings=


NISPUF11$SEQNUMC <- as.character(NISPUF11$SEQNUMC)
NISPUF11$SEQNUMHH <- as.character(NISPUF11$SEQNUMHH)
NISPUF11$XDTPTY1 <- as.character(NISPUF11$XDTPTY1)
NISPUF11$XDTPTY2 <- as.character(NISPUF11$XDTPTY2)
NISPUF11$XDTPTY3 <- as.character(NISPUF11$XDTPTY3)
NISPUF11$XDTPTY4 <- as.character(NISPUF11$XDTPTY4)
NISPUF11$XDTPTY5 <- as.character(NISPUF11$XDTPTY5)
NISPUF11$XDTPTY6 <- as.character(NISPUF11$XDTPTY6)
NISPUF11$XDTPTY7 <- as.character(NISPUF11$XDTPTY7)
NISPUF11$XDTPTY8 <- as.character(NISPUF11$XDTPTY8)
NISPUF11$XDTPTY9 <- as.character(NISPUF11$XDTPTY9)
NISPUF11$XFLUTY1 <- as.character(NISPUF11$XFLUTY1)
NISPUF11$XFLUTY2 <- as.character(NISPUF11$XFLUTY2)
NISPUF11$XFLUTY3 <- as.character(NISPUF11$XFLUTY3)
NISPUF11$XFLUTY4 <- as.character(NISPUF11$XFLUTY4)
NISPUF11$XFLUTY5 <- as.character(NISPUF11$XFLUTY5)
NISPUF11$XFLUTY6 <- as.character(NISPUF11$XFLUTY6)
NISPUF11$XFLUTY7 <- as.character(NISPUF11$XFLUTY7)
NISPUF11$XFLUTY8 <- as.character(NISPUF11$XFLUTY8)
NISPUF11$XFLUTY9 <- as.character(NISPUF11$XFLUTY9)
NISPUF11$XH1NTY1 <- as.character(NISPUF11$XH1NTY1)
NISPUF11$XH1NTY2 <- as.character(NISPUF11$XH1NTY2)
NISPUF11$XH1NTY3 <- as.character(NISPUF11$XH1NTY3)
NISPUF11$XH1NTY4 <- as.character(NISPUF11$XH1NTY4)
NISPUF11$XH1NTY5 <- as.character(NISPUF11$XH1NTY5)
NISPUF11$XH1NTY6 <- as.character(NISPUF11$XH1NTY6)
NISPUF11$XH1NTY7 <- as.character(NISPUF11$XH1NTY7)
NISPUF11$XH1NTY8 <- as.character(NISPUF11$XH1NTY8)
NISPUF11$XH1NTY9 <- as.character(NISPUF11$XH1NTY9)
NISPUF11$XHEPTY1 <- as.character(NISPUF11$XHEPTY1)
NISPUF11$XHEPTY2 <- as.character(NISPUF11$XHEPTY2)
NISPUF11$XHEPTY3 <- as.character(NISPUF11$XHEPTY3)
NISPUF11$XHEPTY4 <- as.character(NISPUF11$XHEPTY4)
NISPUF11$XHEPTY5 <- as.character(NISPUF11$XHEPTY5)
NISPUF11$XHEPTY6 <- as.character(NISPUF11$XHEPTY6)
NISPUF11$XHEPTY7 <- as.character(NISPUF11$XHEPTY7)
NISPUF11$XHEPTY8 <- as.character(NISPUF11$XHEPTY8)
NISPUF11$XHEPTY9 <- as.character(NISPUF11$XHEPTY9)
NISPUF11$XHIBTY1 <- as.character(NISPUF11$XHIBTY1)
NISPUF11$XHIBTY2 <- as.character(NISPUF11$XHIBTY2)
```

```r
NISPUF11$XHIBTY3 <- as.character(NISPUF11$XHIBTY3)
NISPUF11$XHIBTY4 <- as.character(NISPUF11$XHIBTY4)
NISPUF11$XHIBTY5 <- as.character(NISPUF11$XHIBTY5)
NISPUF11$XHIBTY6 <- as.character(NISPUF11$XHIBTY6)
NISPUF11$XHIBTY7 <- as.character(NISPUF11$XHIBTY7)
NISPUF11$XHIBTY8 <- as.character(NISPUF11$XHIBTY8)
NISPUF11$XHIBTY9 <- as.character(NISPUF11$XHIBTY9)
NISPUF11$XMMRTY1 <- as.character(NISPUF11$XMMRTY1)
NISPUF11$XMMRTY2 <- as.character(NISPUF11$XMMRTY2)
NISPUF11$XMMRTY3 <- as.character(NISPUF11$XMMRTY3)
NISPUF11$XMMRTY4 <- as.character(NISPUF11$XMMRTY4)
NISPUF11$XMMRTY5 <- as.character(NISPUF11$XMMRTY5)
NISPUF11$XMMRTY6 <- as.character(NISPUF11$XMMRTY6)
NISPUF11$XMMRTY7 <- as.character(NISPUF11$XMMRTY7)
NISPUF11$XMMRTY8 <- as.character(NISPUF11$XMMRTY8)
NISPUF11$XMMRTY9 <- as.character(NISPUF11$XMMRTY9)
NISPUF11$XPCVTY1 <- as.character(NISPUF11$XPCVTY1)
NISPUF11$XPCVTY2 <- as.character(NISPUF11$XPCVTY2)
NISPUF11$XPCVTY3 <- as.character(NISPUF11$XPCVTY3)
NISPUF11$XPCVTY4 <- as.character(NISPUF11$XPCVTY4)
NISPUF11$XPCVTY5 <- as.character(NISPUF11$XPCVTY5)
NISPUF11$XPCVTY6 <- as.character(NISPUF11$XPCVTY6)
NISPUF11$XPCVTY7 <- as.character(NISPUF11$XPCVTY7)
NISPUF11$XPCVTY8 <- as.character(NISPUF11$XPCVTY8)
NISPUF11$XPCVTY9 <- as.character(NISPUF11$XPCVTY9)
NISPUF11$XPOLTY1 <- as.character(NISPUF11$XPOLTY1)
NISPUF11$XPOLTY2 <- as.character(NISPUF11$XPOLTY2)
NISPUF11$XPOLTY3 <- as.character(NISPUF11$XPOLTY3)
NISPUF11$XPOLTY4 <- as.character(NISPUF11$XPOLTY4)
NISPUF11$XPOLTY5 <- as.character(NISPUF11$XPOLTY5)
NISPUF11$XPOLTY6 <- as.character(NISPUF11$XPOLTY6)
NISPUF11$XPOLTY7 <- as.character(NISPUF11$XPOLTY7)
NISPUF11$XPOLTY8 <- as.character(NISPUF11$XPOLTY8)
NISPUF11$XPOLTY9 <- as.character(NISPUF11$XPOLTY9)
NISPUF11$XROTTY1 <- as.character(NISPUF11$XROTTY1)
NISPUF11$XROTTY2 <- as.character(NISPUF11$XROTTY2)
NISPUF11$XROTTY3 <- as.character(NISPUF11$XROTTY3)
NISPUF11$XROTTY4 <- as.character(NISPUF11$XROTTY4)
NISPUF11$XROTTY5 <- as.character(NISPUF11$XROTTY5)
NISPUF11$XROTTY6 <- as.character(NISPUF11$XROTTY6)
NISPUF11$XROTTY7 <- as.character(NISPUF11$XROTTY7)
NISPUF11$XROTTY8 <- as.character(NISPUF11$XROTTY8)
NISPUF11$XROTTY9 <- as.character(NISPUF11$XROTTY9)
NISPUF11$XVRCTY1 <- as.character(NISPUF11$XVRCTY1)
NISPUF11$XVRCTY2 <- as.character(NISPUF11$XVRCTY2)
NISPUF11$XVRCTY3 <- as.character(NISPUF11$XVRCTY3)
NISPUF11$XVRCTY4 <- as.character(NISPUF11$XVRCTY4)
NISPUF11$XVRCTY5 <- as.character(NISPUF11$XVRCTY5)
NISPUF11$XVRCTY6 <- as.character(NISPUF11$XVRCTY6)
NISPUF11$XVRCTY7 <- as.character(NISPUF11$XVRCTY7)
NISPUF11$XVRCTY8 <- as.character(NISPUF11$XVRCTY8)
NISPUF11$XVRCTY9 <- as.character(NISPUF11$XVRCTY9)
```

```r
nec_data_2011 <- as.data.frame(cbind(NISPUF11$INCQ298A, NISPUF11$STATE, NISPUF11$P_NUMFLU, NISPUF11$P_NU
names(nec_data_2011) <- c("Poverty_Level", "State_of_Residence", "General_Influenza_Vaccinations", "Infl
nec_data_2011 <- transform(nec_data_2011, G = ifelse(General_Influenza_Vaccinations > 0, "yes", "no"),
                           U = ifelse(Influenza_Unknown_Type_Vaccinations > 0, "yes", "no"),
                           S = ifelse(Influenza_Spray_Vaccinations > 0, "yes", "no"),
                           I = ifelse(Influenza_Injection_Vaccinations > 0, "yes", "no"),
                           P = ifelse(Poverty_Level < 3, "yes", "no"))
nec_data_2011 <- nec_data_2011 %>%
mutate(state_of_res = NISPUF11$STATE)

summary(nec_data_2011)
```

```
##  Poverty_Level   State_of_Residence General_Influenza_Vaccinations
##  Min.   : 3.00   Min.   : 1.00      Min.   :0.000
##  1st Qu.: 8.00   1st Qu.:17.00      1st Qu.:0.000
##  Median :13.00   Median :30.00      Median :2.000
##  Mean   :17.36   Mean   :30.66      Mean   :1.599
##  3rd Qu.:14.00   3rd Qu.:46.00      3rd Qu.:3.000
##  Max.   :99.00   Max.   :78.00      Max.   :7.000
##                                     NA's   :7656
##  Influenza_Unknown_Type_Vaccinations Influenza_Spray_Vaccinations
##  Min.   :0.00                        Min.   :0.000
##  1st Qu.:0.00                        1st Qu.:0.000
##  Median :0.00                        Median :0.000
##  Mean   :0.05                        Mean   :0.068
##  3rd Qu.:0.00                        3rd Qu.:0.000
##  Max.   :5.00                        Max.   :4.000
##  NA's   :7656                        NA's   :7656
##  Influenza_Injection_Vaccinations    G            U             S
##  Min.   :0.000                    no  : 6176   no  :19057   no  :18486
##  1st Qu.:0.000                    yes :13473   yes :  592   yes : 1163
##  Median :2.000                    NA's: 7656   NA's: 7656   NA's: 7656
##  Mean   :1.482
##  3rd Qu.:3.000
##  Max.   :7.000
##  NA's   :7656
##     I           P          state_of_res
##  no  : 6734   no:27305   Min.   : 1.00
##  yes :12915              1st Qu.:17.00
##  NA's: 7656              Median :30.00
##                          Mean   :30.66
##                          3rd Qu.:46.00
##                          Max.   :78.00
##
```

Here is the 2011 CDC vaccination data for teenagers. The code and data come from the CDC's National Immunization Survey database (https://www.cdc.gov/vaccines/imz-managers/nis/data-tables.html). This is the code I used for each dataset of each year I looked at. I saved them as Excel files and loaded them into R (as shown below). I only included the process for this base dataset in order to keep the Markup file clean.

Poverty level is shown by "P." To simplify things, I decided to demarcate whether the respondents were at/above or below the specified poverty level by the CDC, to either "no" being below, or "yes" being at or above poverty. For 2011, there were 27,305 responding households that were below the poverty level.

Regarding vaccinations themselves, “G” is the number of general flu vaccinations, “U” is the number of “unknown type” flu vaccinations, “S” is the number of “spray” flu vaccinations, and “I” is the number of “injection” flu vaccinations. There were far more injection flu shots than any other type (12,915).

```
child2007 <- read_excel("child2007.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
child2008 <- read_excel("child2008.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
child2009 <- read_excel("child2009.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
child2010 <- read_excel("child2010.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
child2011 <- read_excel("child2011.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
teen2008 <- read_excel("teen2008.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
teen2009 <- read_excel("teen2009.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
teen2010 <- read_excel("teen_2010_data2.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
teen2011 <- read_excel("teen2011.xlsx")
```

```
## New names:
## * `` -> ...1
```

```
child2008 <- child2008[c(-5,-6,-7,-9,-10,-11)]
child2009 <- child2009[c(-5,-6,-7,-9,-10,-11)]
child2010 <- child2010[c(-5,-6,-7,-9,-10,-11)]
child2011 <- child2011[c(-5,-6,-7,-9,-10,-11)]


teen2008 <- teen2008[c(-5,-6,-8,-9)]
teen2009 <- teen2009[c(-5,-6,-8,-9)]
teen2010 <- teen2010[c(-5,-6,-8,-9)]
teen2011 <- teen2011[c(-5,-6,-7,-9,-10,-11)]
```

Here is some “cleaning” of the data to make sure all the appropriate variables are there for each set. To simplify things, I’m just looking at the general number of influzenza vaccinations.

```r
child_pre_h1 <- rbind(child2007, child2008)
child_h1 <- rbind(child2009)
child_post_h1 <- rbind(child2010, child2011)

teen_pre_h1 <- rbind(teen2008)
teen_h1 <- rbind(teen2009)
teen_post_h1 <- rbind(teen2010) #teen2011 is omitted due to teen data collection beginning one year pri
```

Since I'm interested in comparing vaccination rates before and after the H1N1 pandemic, this is separating the child and teen datasets into three parts each: pre-pandemic, the year of the pandemic, and post-pandemic. To keep the results consistent, I omitted the second year of teen collection data (2011) to compare the same amount of data before and after the pandemic.

```r
child_pre_h1 <- child_pre_h1 %>%
   mutate(State_of_Residence = as.factor(State_of_Residence)) %>%
  mutate(Region = fct_collapse(State_of_Residence, WEST = c("30", "16", "56", "8", "35", "4", "49", "32
```

```
## Warning: Unknown levels in `f`: 78
```

```r
child_h1 <- child_h1 %>%
   mutate(State_of_Residence = as.factor(State_of_Residence)) %>%
  mutate(Region = fct_collapse(State_of_Residence, WEST = c("30", "16", "56", "8", "35", "4", "49", "32

child_post_h1 <- child_post_h1 %>%
   mutate(State_of_Residence = as.factor(State_of_Residence)) %>%
  mutate(Region = fct_collapse(State_of_Residence, WEST = c("30", "16", "56", "8", "35", "4", "49", "32


teen_pre_h1 <- teen_pre_h1 %>%
  mutate(State_of_Residence = as.factor(State_of_Residence)) %>%
  mutate(Region = fct_collapse(State_of_Residence, WEST = c("30", "16", "56", "8", "35", "4", "49", "32
```

```
## Warning: Unknown levels in `f`: 78
```

```r
teen_h1 <- teen_h1 %>%
   mutate(State_of_Residence = as.factor(State_of_Residence)) %>%
  mutate(Region = fct_collapse(State_of_Residence, WEST = c("30", "16", "56", "8", "35", "4", "49", "32

teen_post_h1 <- teen_post_h1 %>%
   mutate(State_of_Residence = as.factor(State_of_Residence)) %>%
  mutate(Region = fct_collapse(State_of_Residence, WEST = c("30", "16", "56", "8", "35", "4", "49", "32
```

Here is more "cleaning" of the data. This separates the specific code values of the states into the four regions that are counted in the U.S. Census:: West, Midwest, South, and Northeast. The Virgin Islands are included as VI.

The Northeast region includes Maine, New Hampshire, Vermont, Massachusetts, New York, Pennsylvania, New Jersey, Connecticut and Rhode Island.

The Midwest region includes North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Michigan and Ohio.

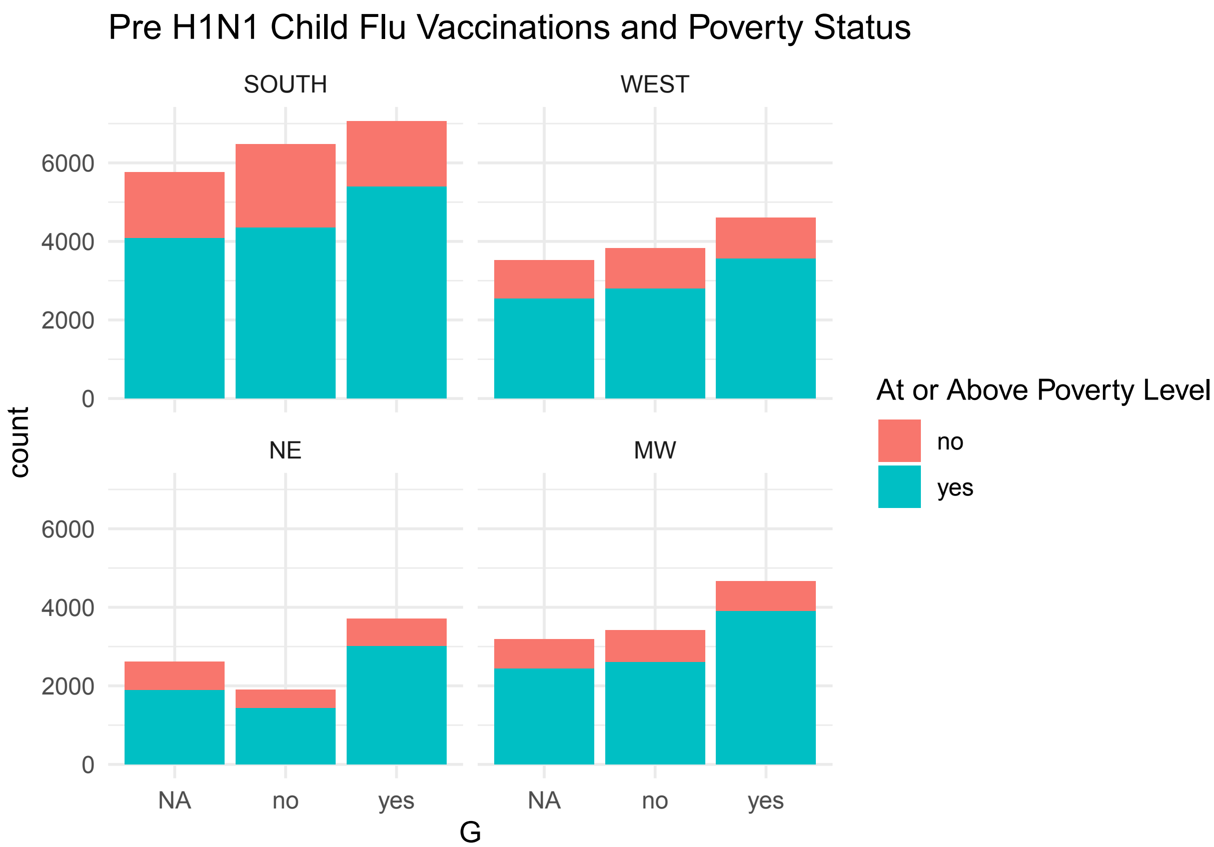
The South region includes Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee, Kentucky, West Virginia, Virginia, Maryland, Delaware and Washington DC.

The West region includes Washington, Oregon, California, Idaho, Montana, Wyoming, Colorado, Utah, Arizona, New Mexico, Nevada, Hawaii and Alaska.

###Comparisons

Here are composite illustrations of all the data combined: vaccination rates and poverty level, grouped into geographic region. The X-axis denotes whether a flu vaccination was received (from left to right: N/A, No, Yes), the number of vaccinations are shown on the Y-axis (in thousands), and the color indicates the proportion of households living either at/above the poverty line (blue) or below the poverty line (red).

```
child_pre_h1 %>%
  drop_na() %>%
  ggplot(aes(x=G, fill=P))+
           geom_bar()+
  facet_wrap(vars(Region), scales = "fixed")+
  labs(title = "Pre H1N1 Child Flu Vaccinations and Poverty Status", xlab("Flu Vaccination"), ylab("Num
  theme_minimal()
```



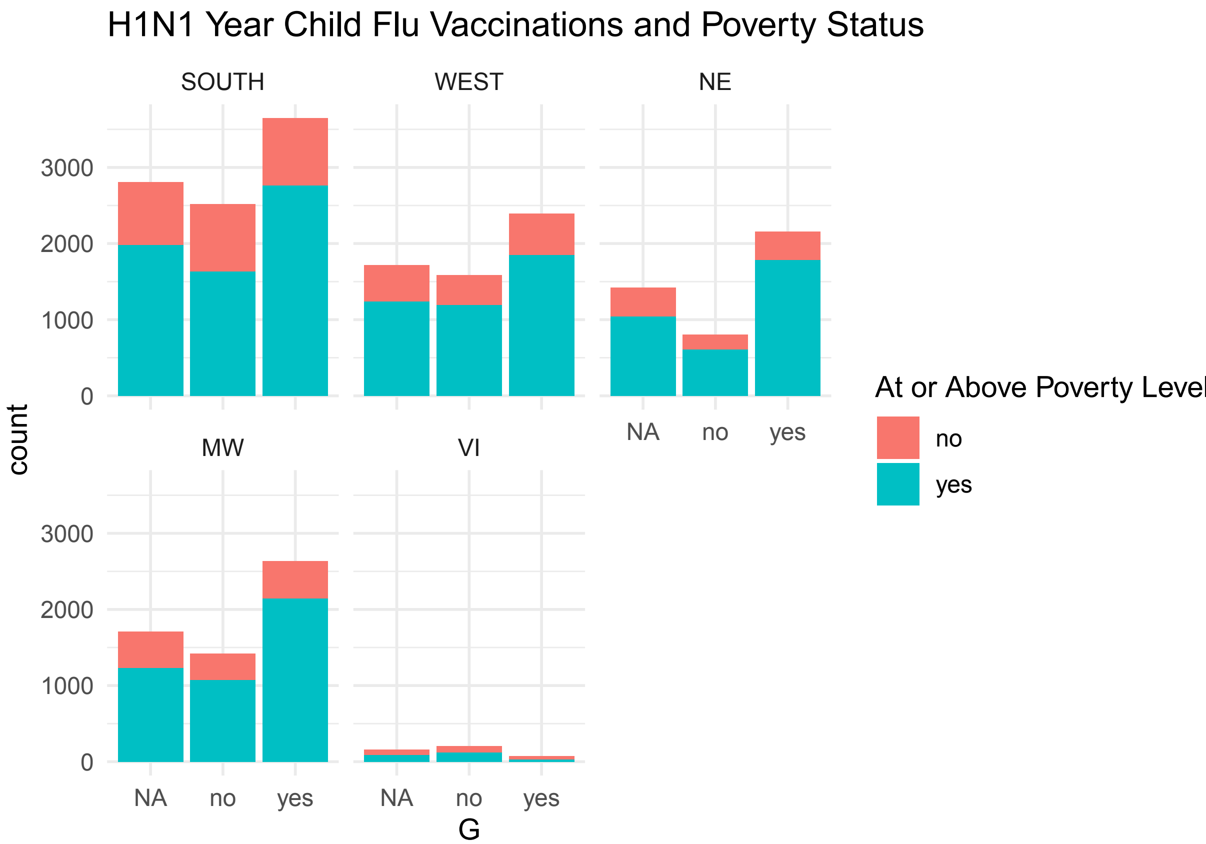

```
child_pre_h1 %>%
  count(P,G=="yes", sort = T)
```

```
## # A tibble: 4 x 3
##   P     `G == "yes"`     n
##   <chr> <lgl>        <int>
## 1 yes   FALSE        22125
## 2 yes   TRUE         15868
## 3 no    FALSE         8589
## 4 no    TRUE          4173
```

This is the childhood data from the two years leading up to the H1N1 outbreak. Of the four regions, it appears the South has the highest number of vaccinations, but they also have the largest population of the four. The table shows the intersection between households at or above the poverty line ("yes" in the column

“P”) and whether they were vaccinated (“FALSE” for not vaccinated, “TRUE” for vaccinated in the column “G==‘yes’ ”). Before the outbreak, the number of households living at or above the poverty line receiving a child flu vaccination was 15,868. Of those living below the poverty line, 4,173 received a vaccination.

```
child_h1 %>%
  drop_na() %>%
  ggplot(aes(x=G, fill=P))+
           geom_bar()+
  facet_wrap(vars(Region), scales = "fixed")+
  labs(title = "H1N1 Year Child Flu Vaccinations and Poverty Status", xlab("Flu Vaccination"), ylab("Nu
  theme_minimal()
```

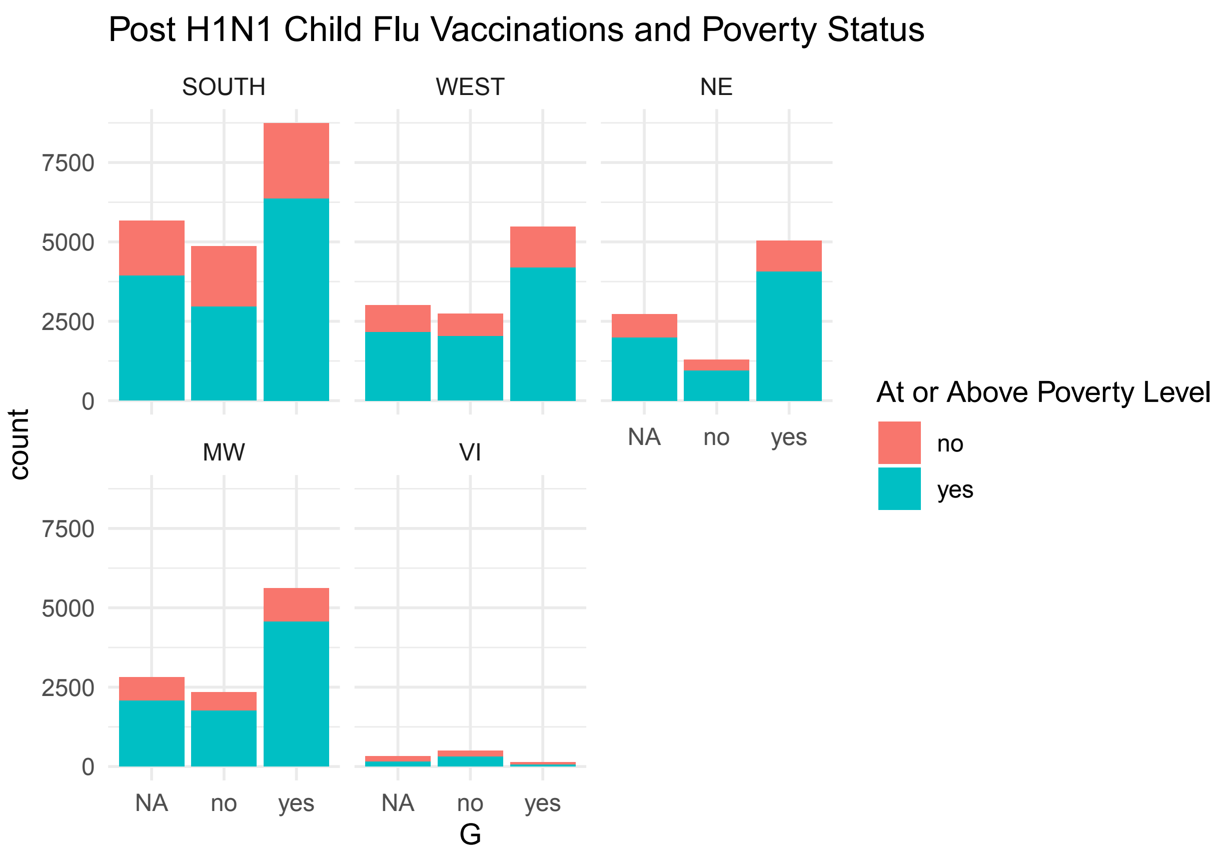



```
child_h1 %>%
  count(P,G=="yes", sort = T)
```

```
## # A tibble: 4 x 3
##   P     `G == "yes"`     n
##   <chr> <lgl>        <int>
## 1 yes   FALSE        10201
## 2 yes   TRUE          8568
## 3 no    FALSE         4142
## 4 no    TRUE          2330
```

During the year of the pandemic, the proportion of child vaccination rates remains relatively similar in geographic distribution compared to the years prior. The number of households living at or above poverty and getting vaccinated was 8,568, and those living below poverty and getting vaccinated was 2,330. It should be reminded that if the difference between pre-H1N1 and during H1N1 numbers seem large, the pre-H1N1 analysis took two years of data into account compared to the single outbreak year. This was the year the Virgin Islands were included in the analysis, but they did not record a significant amount of child vaccinations.

```
child_post_h1 %>%
  drop_na() %>%
  ggplot(aes(x=G, fill=P))+
           geom_bar()+
  facet_wrap(vars(Region), scales = "fixed")+
  labs(title = "Post H1N1 Child Flu Vaccinations and Poverty Status", xlab("Flu Vaccination"), ylab("Nu
  theme_minimal()
```




```
child_post_h1 %>%
  count(P,G=="yes", sort = T)
```

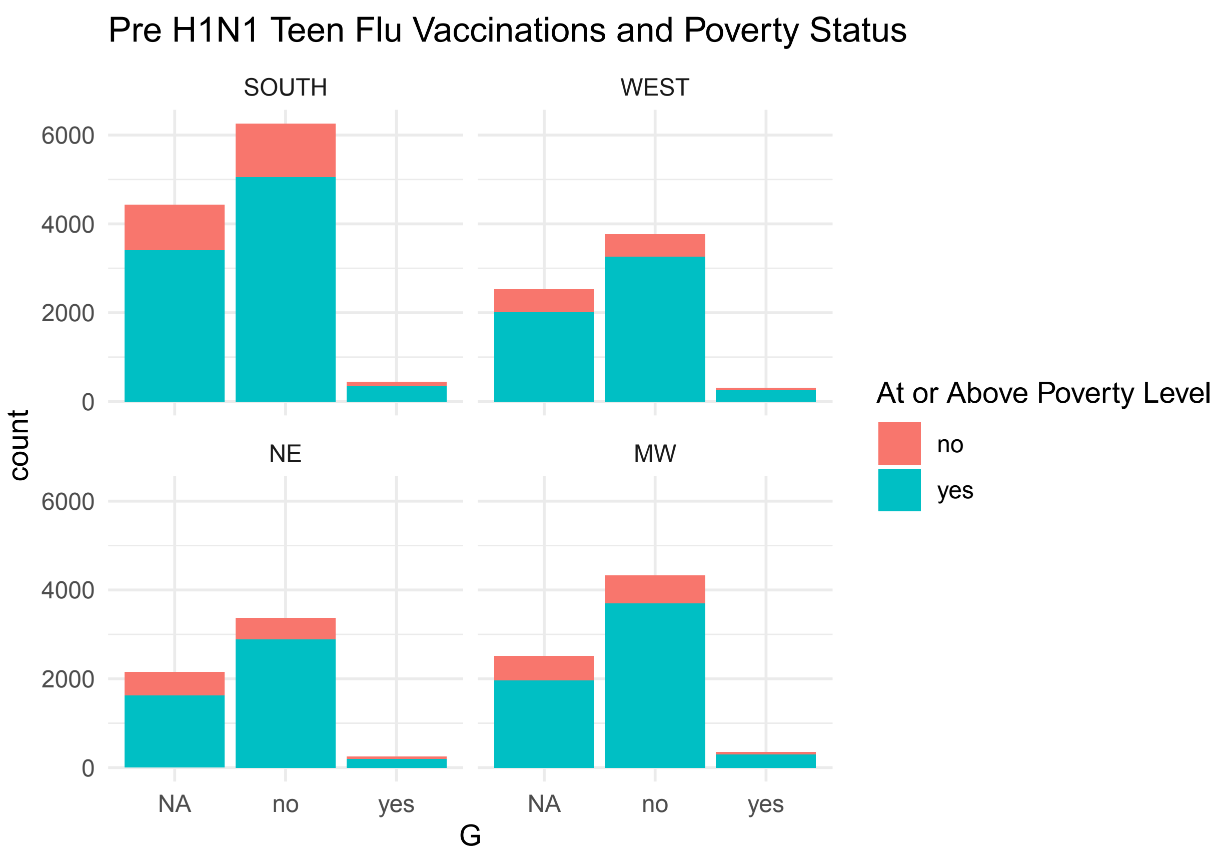
```
## # A tibble: 4 x 3
##   P     `G == "yes"`     n
##   <chr> <lgl>        <int>
## 1 yes   TRUE         19240
## 2 yes   FALSE        18330
## 3 no    FALSE         7972
## 4 no    TRUE          5776
```

Following the pandemic, there is a slight increase in families receiving child vaccinations living both at/above (18,330) and below poverty (5,776) compared to the years prior to the pandemic. The geographic distribution remains relatively stable throughout all the analysis. It should be noted that there was a larger total number of collected surveys, so the uptick in vaccinations is not as great as it may appear on the surface.

Here is the teenager vaccination data.

```
teen_pre_h1 %>%
  drop_na() %>%
  ggplot(aes(x=G, fill=P))+
```

```
            geom_bar()+
  facet_wrap(vars(Region), scales = "fixed")+
  labs(title = "Pre H1N1 Teen Flu Vaccinations and Poverty Status", xlab("Flu Vaccination"), ylab("Numbe
  theme_minimal()
```



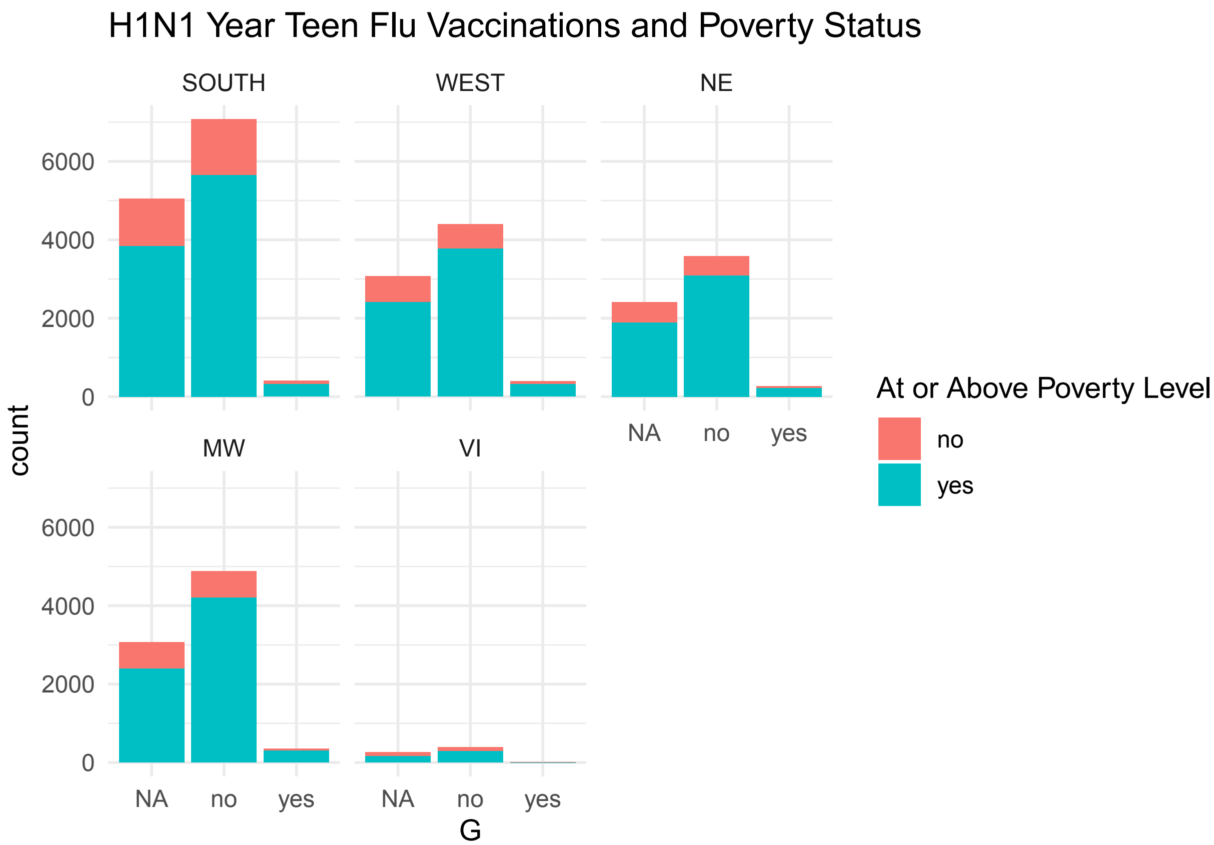

```
teen_pre_h1 %>%
  count(P,G=="yes", sort = T)
```

```
## # A tibble: 4 x 3
##   P     `G == "yes"`     n
##   <chr> <lgl>        <int>
## 1 yes   FALSE        23899
## 2 no    FALSE         5446
## 3 yes   TRUE          1089
## 4 no    TRUE           247
```

In the year prior to the pandemic, only 1,089 families living at/above the poverty line received a teenage vaccination, and 247 living below the poverty line received one. Considering nearly 24,000 families at or above poverty didn't get a teenage vaccination, that's a stark difference compared to the child vaccination numbers. Geographically, the South remains the biggest contributor to the statistics, although the general distribution is the same across the nation.

```
teen_h1 %>%
  drop_na() %>%
  ggplot(aes(x=G, fill=P))+
            geom_bar()+
  facet_wrap(vars(Region), scales = "fixed")+
  labs(title = "H1N1 Year Teen Flu Vaccinations and Poverty Status", xlab("Flu Vaccination"), ylab("Numb
```

```
  theme_minimal()
```

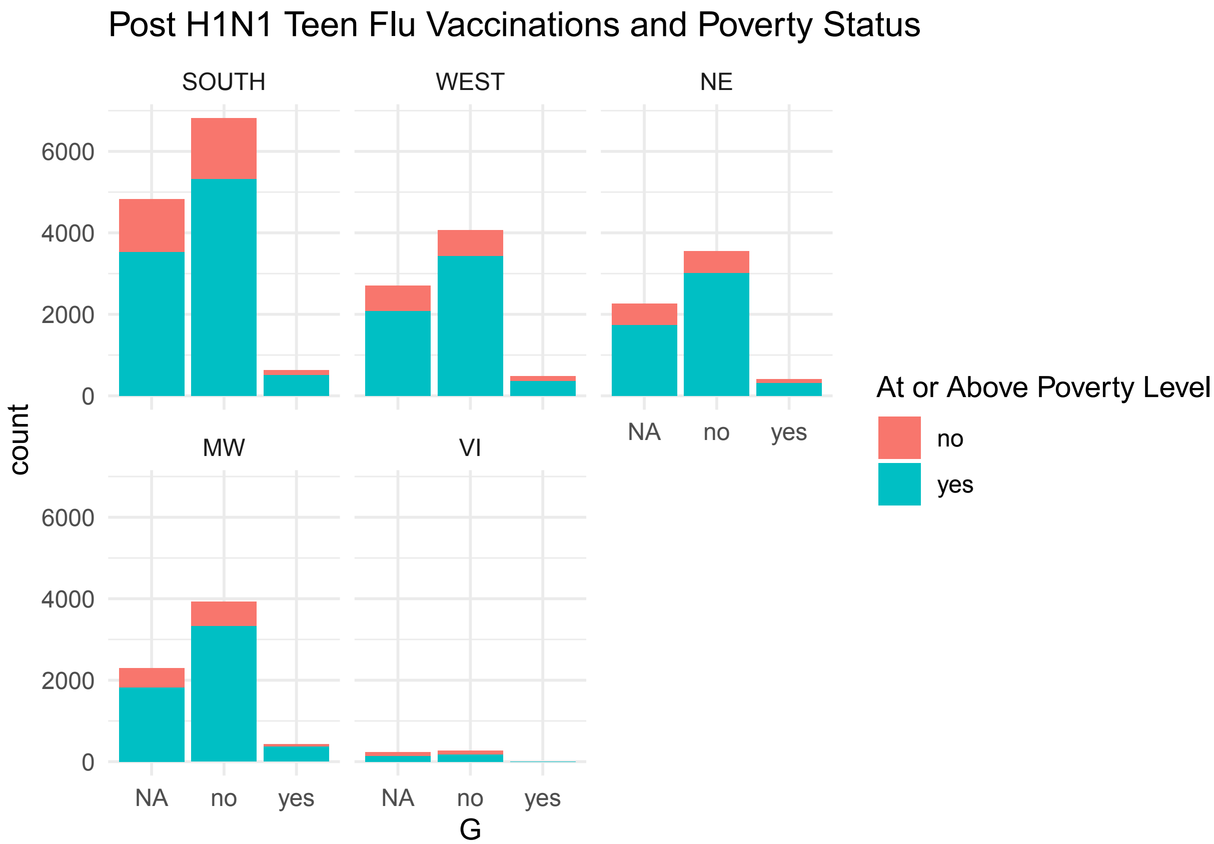



```
teen_h1 %>%
  count(P,G=="yes", sort = T)
```

```
## # A tibble: 4 x 3
##   P     `G == "yes"`     n
##   <chr> <lgl>        <int>
## 1 yes   FALSE        27707
## 2 no    FALSE         6495
## 3 yes   TRUE          1154
## 4 no    TRUE           281
```

In the year of the pandemic, 1,154 families at or above poverty received teenage vaccinations, and 281 families below poverty were vaccinated. An extremely small number, especially since there was a greater number of collected surveys: nearly 28,000 families at or above poverty didn't report a teenage vaccination the year of the H1N1 pandemic. Geographic distribution is consistent with the year prior.

```
teen_post_h1 %>%
  drop_na() %>%
  ggplot(aes(x=G, fill=P))+
           geom_bar()+
  facet_wrap(vars(Region), scales = "fixed")+
  labs(title = "Post H1N1 Teen Flu Vaccinations and Poverty Status", xlab("Flu Vaccination"), ylab("Numl
  theme_minimal()
```




```r
teen_post_h1 %>%
  count(P,G=="yes", sort = T)
```

```
## # A tibble: 4 x 3
##   P     `G == "yes"`     n
##   <chr> <lgl>        <int>
## 1 yes   FALSE        24558
## 2 no    FALSE         6408
## 3 yes   TRUE          1549
## 4 no    TRUE           418
```

Following the pandemic, 1,549 of of the households living at or above the poverty line received teenager flu vaccinations, and 24,558 did not. Of those households living below the poverty line, 6,408 received teenager vaccinations, and 418 did not. Compared to the year prior there is a slight increase, but still a discouragingly low teenage vaccination rate. Once again geographic distribution remains similar to the years prior.

###Discussion

After analyzing the immunization data, it suggests that the H1N1 pandemic did not significantly increase the number of reported influenza immunizations in children or teenagers. This is important information, as it could be reasoned that most people would want to become vaccinated following a pandemic if that had not done so in the years leading up to it in order to protect themselves. However, the data shown here does not support that line of thinking. This suggests that vaccination education should continue to be a public health focus in the future, in order to reduce the likelihood of outbreaks of preventable diseases such as influenza. The geographic distribution remained consistent throughout all years of analysis presented in this project. This suggests that these numbers are relatively stable in each geographic region, and public health efforts can use this data to increase funding and education in areas that have a higher density of population, but perhaps a lower rate of vaccination. The evidence that all the regions had relatively similar vaccination rates despite large population differences shows that geographic regions play less of a role in terms of specific public health education and vaccination, and more efforts can be made on a national scale to increase vaccination. From the data analyzed, the socioeconomic data was encouraging. Even though less total vaccinations came from households below the poverty line, there was a far lower number of those living below poverty compared to those living at/above poverty. Additionally, the proportion of vaccinations that were given to those below poverty were congruent with the households at/above the poverty line. This suggests that those living below poverty are still able to access vaccination resources should they seek them out, which is positive for public health standards. However, this does not mean that education and accessibility to these resources is “good enough” but rather the data should be used to find ways to make this crucial healthcare item even more accessible to all people, regardless of income status. There are several differences to note. To begin, the number of teenage and child vaccinations differed greatly. While it could suggest that teenagers are less likely to be vaccinated in general, it could also reflect that there are more households with young children compared to teenagers. Childhood is also a time where many vaccinations are given in order to build up immunity for life, and parents are more likely to take a young child in for a routine vaccination or checkup compared to a teenager who may have more autonomy. Additionally, the teenage data which was analyzed had one less year of data compared to the child data, due to teenage vaccination records becoming available in 2008. Finally, the datasets had a large number of “N/A” responses. This answer indicates that getting a influenza vaccination did not apply to the household, which could be interpreted as the household not recieving a vaccination. This would greatly increase the number of non-vaccinated responses, which would show that far more people in the country did not receive a seasonal influenza vaccine compared to those who did, further highlighting the need for increased education and awareness around the benefits and importance of receiving vaccines.

In conclusion, the H1N1 pandemic did not significantly alter the number of childhood or teenage influenza vaccinations from the two years prior to the pandemic compared to the two years following the pandemic. Furthermore, vaccination rates by geographic region and socioeconomic status did not significantly change from before to after the pandemic.