Final_Report

2025-11-23

Introduction

The National Health Interview Survey (NHIS) is a large, nationally representative survey of the U.S. population. In this project, we examine how demographic characteristics, body measurements, general health, and life satisfaction relate to one another. Our analysis uses the 2021 NHIS Sample Adult File and focuses on age (AGEP_A), sex (SEX_A), education (EDUCP_A), height (HEIGHTTC_A), weight (WEIGHTLBTC_A), general health (PHSTAT_A), and life satisfaction (LSATIS4R_A).

Methods

We used the cleaned dataset created earlier in our project and saved as `nhis_clean.csv`. After importing the dataset, we converted several variables to factors with meaningful labels and produced descriptive statistics, univariate plots, bivariate comparisons, and multivariate visualizations. Height–weight trends and correlations among age, height, and weight were examined using both ggplot2 and psych’s `pairs.panels()` function.

Day 1

```
library(readr)#loading package
library(tidyverse)#loading package
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✔ dplyr     1.1.4     ✔ purrr     1.0.4
## ✔ forcats   1.0.0     ✔ stringr   1.5.1
## ✔ ggplot2   4.0.0     ✔ tibble    3.2.1
## ✔ lubridate 1.9.4     ✔ tidyr     1.3.1
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become
errors
```

```
setwd("/Users/lesleythompson/Desktop/Pubh 422/NHIS2021_Group3/Data")#set working directory within
files on my computer
NHIS_2021 <- read.csv("NHIS _Data_2021.csv", header = TRUE) #load hints dataset
View(NHIS_2021)#look at whole data set
str(NHIS_2021)#gives data structure
```

```
## 'data.frame':    29482 obs. of  18 variables:
##  $ DEMENEV_A   : int  2 2 2 2 2 2 2 2 2 2 ...
##  $ COPDEV_A    : int  2 2 2 2 2 2 2 2 2 2 ...
##  $ HYPEV_A     : int  1 1 2 1 2 1 2 2 2 2 ...
##  $ DEPEV_A     : int  2 2 2 2 2 2 2 2 2 1 ...
##  $ CANEV_A     : int  2 2 2 2 2 2 2 2 2 2 ...
##  $ DIBEV_A     : int  2 1 2 2 2 2 2 2 2 2 ...
##  $ AGEP_A      : int  50 53 56 57 25 55 45 41 26 71 ...
##  $ SEX_A       : int  1 1 1 2 1 1 1 1 2 2 ...
##  $ HISPALLP_A  : int  2 3 2 2 3 3 2 3 3 2 ...
##  $ MARSTAT_A   : int  5 6 5 7 9 9 1 1 7 1 ...
##  $ EDUCP_A     : int  1 7 8 5 4 5 9 5 4 9 ...
##  $ PHSTAT_A    : int  2 2 2 4 3 3 1 1 2 1 ...
##  $ LSATIS4R_A  : int  2 1 3 2 8 8 1 1 1 1 ...
##  $ SMKCIGST_A  : int  3 4 3 3 9 9 4 4 4 4 ...
##  $ RATCAT_A    : int  7 12 14 11 6 6 14 14 7 14 ...
##  $ BMICAT_A    : int  3 3 3 4 4 3 9 3 4 2 ...
##  $ WEIGHTLBTC_A: int  199 205 160 190 250 200 997 206 996 127 ...
##  $ HEIGHTTC_A  : int  69 75 67 63 72 69 67 72 96 63 ...
```

```
head(NHIS_2021)#print first 6 rows of data
```

```
##   DEMENEV_A COPDEV_A HYPEV_A DEPEV_A CANEV_A DIBEV_A AGEP_A SEX_A HISPALLP_A
## 1         2        2       1       2       2       2     50     1          2
## 2         2        2       1       2       2       1     53     1          3
## 3         2        2       2       2       2       2     56     1          2
## 4         2        2       1       2       2       2     57     2          2
## 5         2        2       2       2       2       2     25     1          3
## 6         2        2       1       2       2       2     55     1          3
##   MARSTAT_A EDUCP_A PHSTAT_A LSATIS4R_A SMKCIGST_A RATCAT_A BMICAT_A
## 1         5       1        2          2          3        7        3
## 2         6       7        2          1          4       12        3
## 3         5       8        2          3          3       14        3
## 4         7       5        4          2          3       11        4
## 5         9       4        3          8          9        6        4
## 6         9       5        3          8          9        6        3
##   WEIGHTLBTC_A HEIGHTTC_A
## 1          199         69
## 2          205         75
## 3          160         67
## 4          190         63
## 5          250         72
## 6          200         69
```

```
summary(NHIS_2021)# gives summary of data
```

```
##    DEMENEV_A        COPDEV_A        HYPEV_A         DEPEV_A
##  Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000
##  1st Qu.:2.000   1st Qu.:2.000   1st Qu.:1.000   1st Qu.:2.000
##  Median :2.000   Median :2.000   Median :2.000   Median :2.000
##  Mean   :1.993   Mean   :1.951   Mean   :1.648   Mean   :1.829
##  3rd Qu.:2.000   3rd Qu.:2.000   3rd Qu.:2.000   3rd Qu.:2.000
##  Max.   :9.000   Max.   :9.000   Max.   :9.000   Max.   :9.000
##     CANEV_A         DIBEV_A        AGEP_A          SEX_A         HISPALLP_A
##  Min.   :1.000   Min.   :1.0   Min.   :18.00   Min.   :1.000   Min.   :1.000
##  1st Qu.:2.000   1st Qu.:2.0   1st Qu.:37.00   1st Qu.:1.000   1st Qu.:2.000
##  Median :2.000   Median :2.0   Median :53.00   Median :2.000   Median :2.000
##  Mean   :1.882   Mean   :1.9   Mean   :52.63   Mean   :1.547   Mean   :2.203
##  3rd Qu.:2.000   3rd Qu.:2.0   3rd Qu.:68.00   3rd Qu.:2.000   3rd Qu.:2.000
##  Max.   :9.000   Max.   :9.0   Max.   :99.00   Max.   :9.000   Max.   :7.000
##    MARSTAT_A        EDUCP_A          PHSTAT_A      LSATIS4R_A
##  Min.   :1.000   Min.   : 1.000   Min.   :1.00   Min.   :1.000
##  1st Qu.:1.000   1st Qu.: 4.000   1st Qu.:2.00   1st Qu.:1.000
##  Median :4.000   Median : 6.000   Median :2.00   Median :2.000
##  Mean   :3.858   Mean   : 6.447   Mean   :2.39   Mean   :1.748
##  3rd Qu.:7.000   3rd Qu.: 8.000   3rd Qu.:3.00   3rd Qu.:2.000
##  Max.   :9.000   Max.   :99.000   Max.   :9.00   Max.   :9.000
##    SMKCIGST_A       RATCAT_A         BMICAT_A      WEIGHTLBTC_A
##  Min.   :1.000   Min.   : 1.000   Min.   :1.000   Min.   :100.0
##  1st Qu.:3.000   1st Qu.: 7.000   1st Qu.:2.000   1st Qu.:150.0
##  Median :4.000   Median :11.000   Median :3.000   Median :180.0
##  Mean   :3.579   Mean   : 9.848   Mean   :3.121   Mean   :248.8
##  3rd Qu.:4.000   3rd Qu.:14.000   3rd Qu.:4.000   3rd Qu.:215.0
##  Max.   :9.000   Max.   :14.000   Max.   :9.000   Max.   :999.0
##    HEIGHTTC_A
##  Min.   :59.00
##  1st Qu.:64.00
##  Median :67.00
##  Mean   :68.72
##  3rd Qu.:70.00
##  Max.   :99.00
```

Day 2

```
attach(NHIS_2021)
subNHIS <- NHIS_2021 %>%
  select(AGEP_A, WEIGHTLBTC_A, HEIGHTTC_A, SEX_A, HISPALLP_A, EDUCP_A, PHSTAT_A, LSATIS4R_A)
#allows us to select only the variables required for analysis, helps prevent the removal of more p
articipants than necessary
View(subNHIS)#making sure only the selected variables show up
sum(is.na(subNHIS))
```

```
## [1] 0
```

```
#missing values in the code book are 97-99,7, 9, and 996-999 depending on the variable, excluded b
elow by only including values outside of missing
NHIS_omit <- subNHIS[c(AGEP_A <97 & WEIGHTLBTC_A <996 & HEIGHTTC_A <96 & SEX_A <3 & HISPALLP_A <8
& EDUCP_A <11 & PHSTAT_A <6 & LSATIS4R_A <5),]
#Checking to make sure missing values have been ommitted
summary(NHIS_omit)
```

```
##      AGEP_A       WEIGHTLBTC_A     HEIGHTTC_A       SEX_A        HISPALLP_A
##  Min.   :18.00   Min.   :100.0   Min.   :59.0   Min.   :1.00   Min.   :1.000
##  1st Qu.:37.00   1st Qu.:147.0   1st Qu.:64.0   1st Qu.:1.00   1st Qu.:2.000
##  Median :54.00   Median :173.0   Median :66.0   Median :2.00   Median :2.000
##  Mean   :52.57   Mean   :176.8   Mean   :66.7   Mean   :1.54   Mean   :2.197
##  3rd Qu.:67.00   3rd Qu.:200.0   3rd Qu.:70.0   3rd Qu.:2.00   3rd Qu.:2.000
##  Max.   :85.00   Max.   :299.0   Max.   :76.0   Max.   :2.00   Max.   :7.000
##     EDUCP_A          PHSTAT_A       LSATIS4R_A
##  Min.   : 1.000   Min.   :1.000   Min.   :1.000
##  1st Qu.: 4.000   1st Qu.:2.000   1st Qu.:1.000
##  Median : 6.000   Median :2.000   Median :2.000
##  Mean   : 6.032   Mean   :2.346   Mean   :1.583
##  3rd Qu.: 8.000   3rd Qu.:3.000   3rd Qu.:2.000
##  Max.   :10.000   Max.   :5.000   Max.   :4.000
```

```
#seeing how much data was removed from the dataset
str(NHIS_omit)
```

```
## 'data.frame':    26037 obs. of  8 variables:
##  $ AGEP_A      : int  50 53 56 57 41 71 69 44 69 59 ...
##  $ WEIGHTLBTC_A: int  199 205 160 190 206 127 100 208 165 225 ...
##  $ HEIGHTTC_A  : int  69 75 67 63 72 63 63 69 71 70 ...
##  $ SEX_A       : int  1 1 1 2 1 2 2 1 1 1 ...
##  $ HISPALLP_A  : int  2 3 2 2 3 2 2 2 2 2 ...
##  $ EDUCP_A     : int  1 7 8 5 5 9 9 8 4 8 ...
##  $ PHSTAT_A    : int  2 2 2 4 1 1 1 2 2 3 ...
##  $ LSATIS4R_A  : int  2 1 3 2 1 1 1 2 1 1 ...
```

```
#creating new levels from 1-4 based on the codebook by excluding all values not in that section
NHIS_omit$EDUCP_A[NHIS_omit$EDUCP_A >=0 & NHIS_omit$EDUCP_A <=3] = 1
NHIS_omit$EDUCP_A[NHIS_omit$EDUCP_A == 4] = 2
NHIS_omit$EDUCP_A[NHIS_omit$EDUCP_A >=5 & NHIS_omit$EDUCP_A <=7] = 3
NHIS_omit$EDUCP_A[NHIS_omit$EDUCP_A >=8 & NHIS_omit$EDUCP_A <=10] = 4
#making sure the new levels are working
summary(NHIS_omit$EDUCP_A)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   2.000   3.000   2.971   4.000   4.000
```

```
#adding the labels to the new levels for education using the NHIS 2021 codebook
NHIS_2021_clean <- NHIS_omit %>%
  mutate(EDUCP_A = factor(EDUCP_A,
                          levels = c(1,2,3,4),
                          labels = c("less than High School","High School Graduate", "Some College
Education","College Graduate or better")))
#Making sure data labels are showing up properly
summary(NHIS_2021_clean$EDUCP_A)
```

```
##      less than High School       High School Graduate
##                       2676                       5765
##     Some College Education College Graduate or better
##                       7238                      10358
```

```
#making sure that education is now a factor variable with meaningful labels
str(NHIS_2021_clean$EDUCP_A)
```

```
##  Factor w/ 4 levels "less than High School",..: 1 3 4 3 3 4 4 4 2 4 ...
```

```
View(NHIS_2021_clean)
#creating the cleaned .csv file for submission, with the help function
?write.csv
write.csv(NHIS_2021_clean, "nhis_clean.csv")
```

Day 3

```
# Load required library for ggplot2
library(ggplot2)

# Check first few rows and column names
head(NHIS_2021_clean)
```

```
##    AGEP_A WEIGHTLBTC_A HEIGHTTC_A SEX_A HISPALLP_A                    EDUCP_A
## 1      50          199         69     1          2      less than High School
## 2      53          205         75     1          3     Some College Education
## 3      56          160         67     1          2 College Graduate or better
## 4      57          190         63     2          2     Some College Education
## 8      41          206         72     1          3     Some College Education
## 10     71          127         63     2          2 College Graduate or better
##    PHSTAT_A LSATIS4R_A
## 1         2          2
## 2         2          1
## 3         2          3
## 4         4          2
## 8         1          1
## 10        1          1
```

```
names(NHIS_2021_clean)
```

```
## [1] "AGEP_A"       "WEIGHTLBTC_A" "HEIGHTTC_A"   "SEX_A"        "HISPALLP_A"  
## [6] "EDUCP_A"      "PHSTAT_A"     "LSATIS4R_A"
```

```
######DAY 3
#### Task 1
###Summary Statistics

#Quantitative Variables

# 1. Age (AGEP_A)
cat("=== AGE (AGEP_A) ===\n")
```

```
## === AGE (AGEP_A) ===
```

```
summary(NHIS_2021_clean$AGEP_A)                     # Min, 1st Qu., Median, Mean, 3rd Qu., Max
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   18.00   37.00   54.00   52.57   67.00   85.00
```

```
cat("Mean:", mean(NHIS_2021_clean$AGEP_A, na.rm=TRUE), "\n")
```

```
## Mean: 52.57107
```

```
cat("Median:", median(NHIS_2021_clean$AGEP_A, na.rm=TRUE), "\n")
```

```
## Median: 54
```

```
cat("Standard Deviation:", sd(NHIS_2021_clean$AGEP_A, na.rm=TRUE), "\n\n")
```

```
## Standard Deviation: 18.33484
```

```
# 2. Weight (WEIGHTLBTC_A)
cat("=== WEIGHT (WEIGHTLBTC_A) ===\n")
```

```
## === WEIGHT (WEIGHTLBTC_A) ===
```

```
summary(NHIS_2021_clean$WEIGHTLBTC_A)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   100.0   147.0   173.0   176.8   200.0   299.0
```

```
cat("Mean:", mean(NHIS_2021_clean$WEIGHTLBTC_A, na.rm=TRUE), "\n")
```

```
## Mean: 176.8261
```

```
cat("Median:", median(NHIS_2021_clean$WEIGHTLBTC_A, na.rm=TRUE), "\n")
```

```
## Median: 173
```

```
cat("Standard Deviation:", sd(NHIS_2021_clean$WEIGHTLBTC_A, na.rm=TRUE), "\n\n")
```

```
## Standard Deviation: 39.59538
```

```
# 3. Height (HEIGHTTC_A)
cat("=== HEIGHT (HEIGHTTC_A) ===\n")
```

```
## === HEIGHT (HEIGHTTC_A) ===
```

```
summary(NHIS_2021_clean$HEIGHTTC_A)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##    59.0    64.0    66.0    66.7    70.0    76.0
```

```
cat("Mean:", mean(NHIS_2021_clean$HEIGHTTC_A, na.rm=TRUE), "\n")
```

```
## Mean: 66.70108
```

```
cat("Median:", median(NHIS_2021_clean$HEIGHTTC_A, na.rm=TRUE), "\n")
```

```
## Median: 66
```

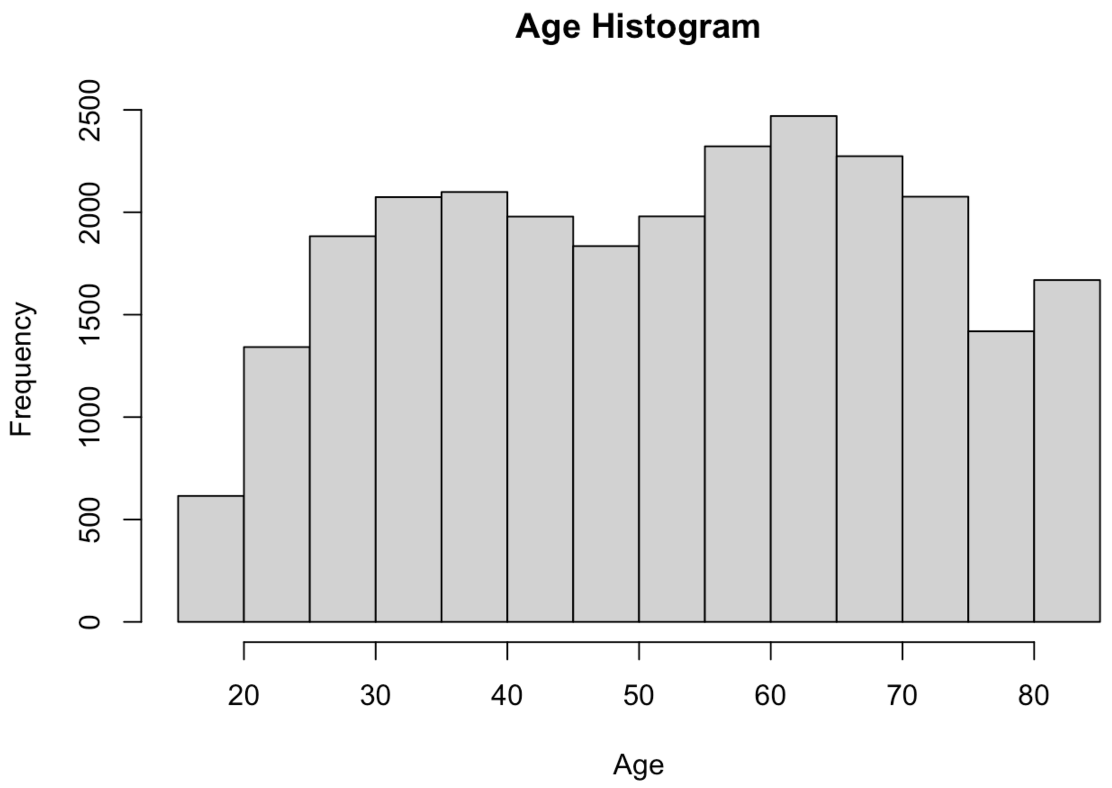
```
cat("Standard Deviation:", sd(NHIS_2021_clean$HEIGHTTC_A, na.rm=TRUE), "\n")
```

```
## Standard Deviation: 3.898793
```

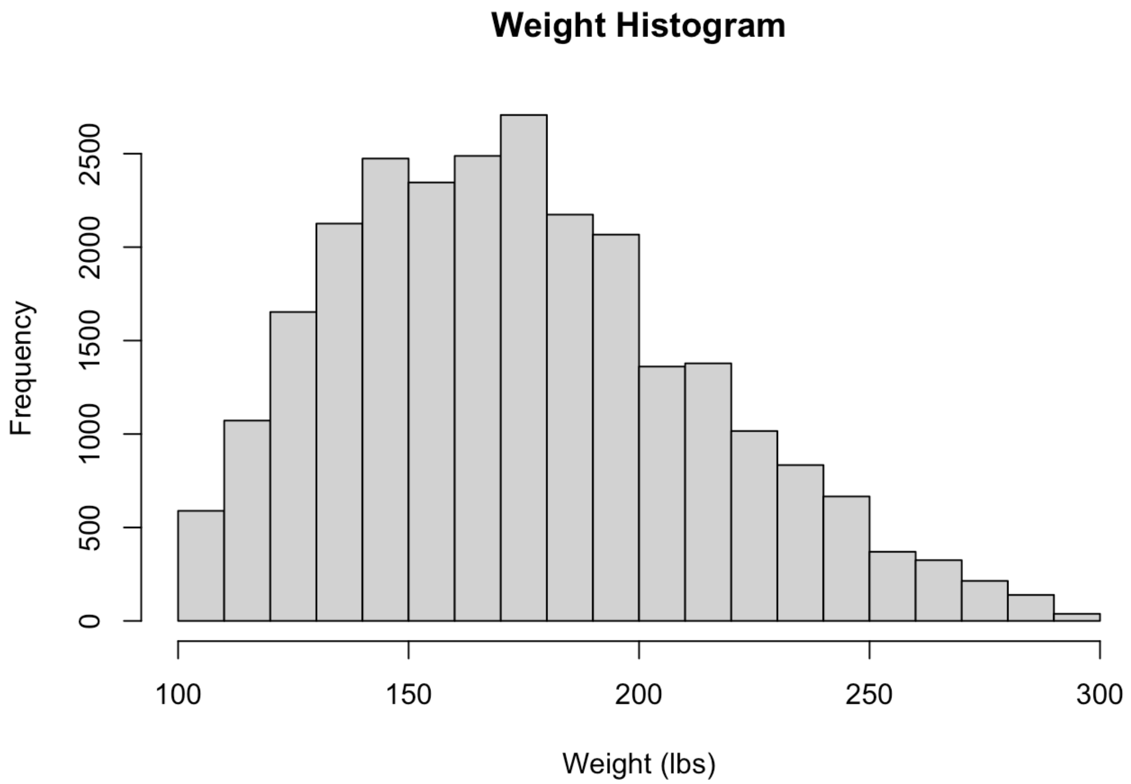
Interpretation:

The NHIS_2021_clean data set had a mean age of 52.57 (SD = 18.33), the minimum age was 18, and the maximum age was 85 The mean weight was 176.8 (SD = 39.59), with a minimum of 100, and a maximum of 299. The mean height was 66.7 inches (3.89) with a minimum of 59, and a maximum of 79. Looking at these descriptive statistics give a preliminary understanding of who this data is representing, and is important when drawing conclusions for future statistical analyses.

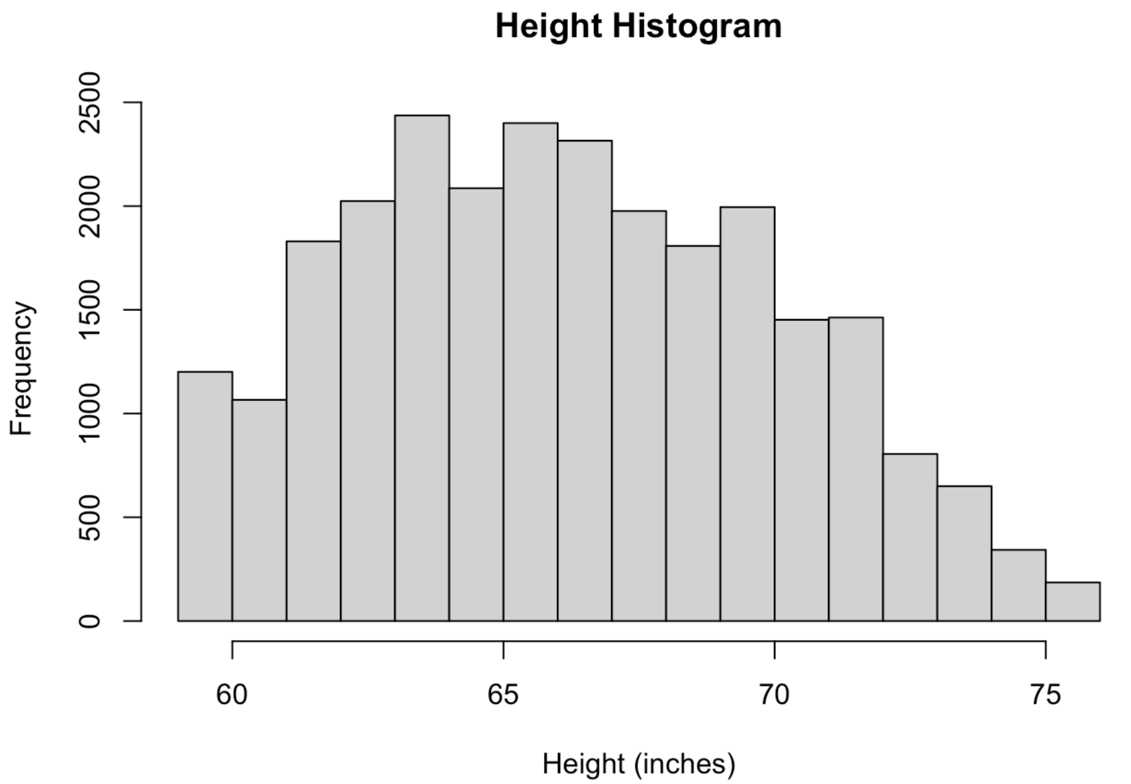
```
### Base R Histograms
hist(NHIS_2021_clean$AGEP_A, main="Age Histogram", xlab="Age")
```



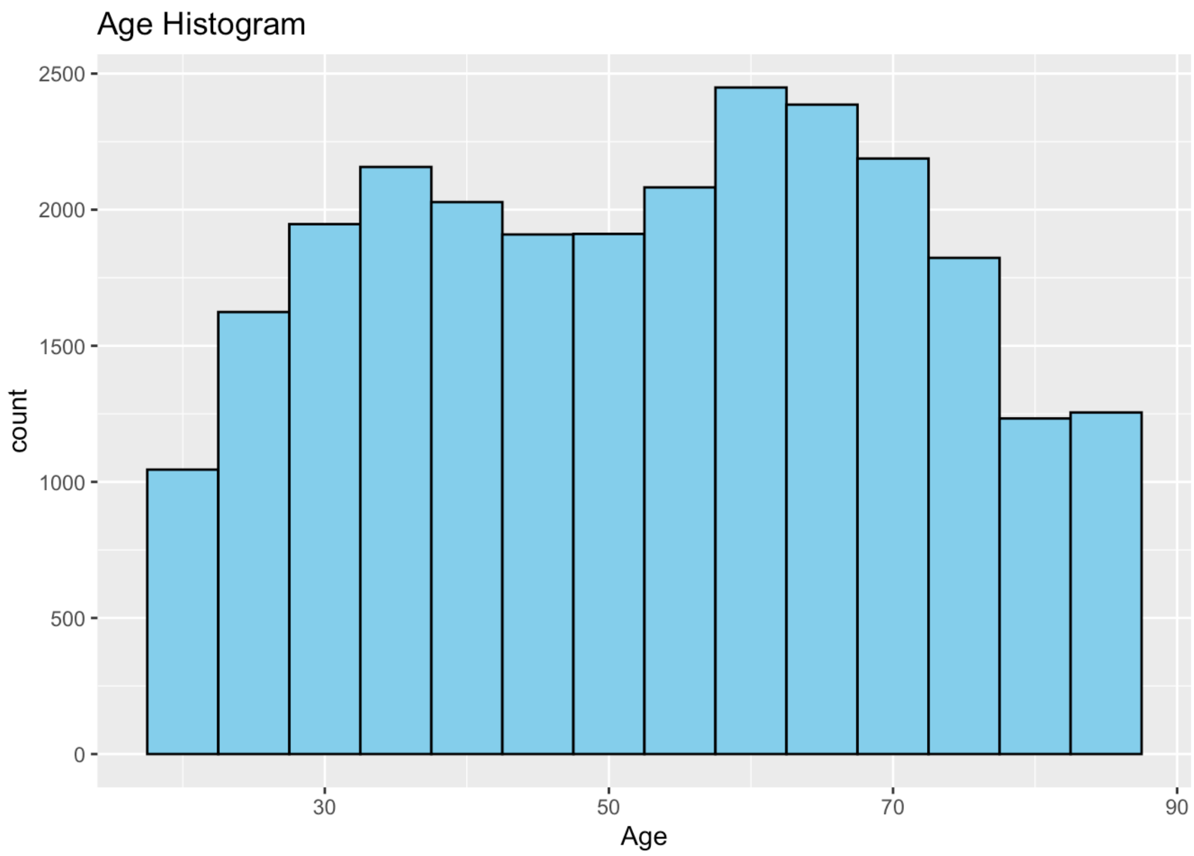
```
hist(NHIS_2021_clean$WEIGHTLBTC_A, main="Weight Histogram", xlab="Weight (lbs)")
```



```
hist(NHIS_2021_clean$HEIGHTTC_A, main="Height Histogram", xlab="Height (inches)")
```

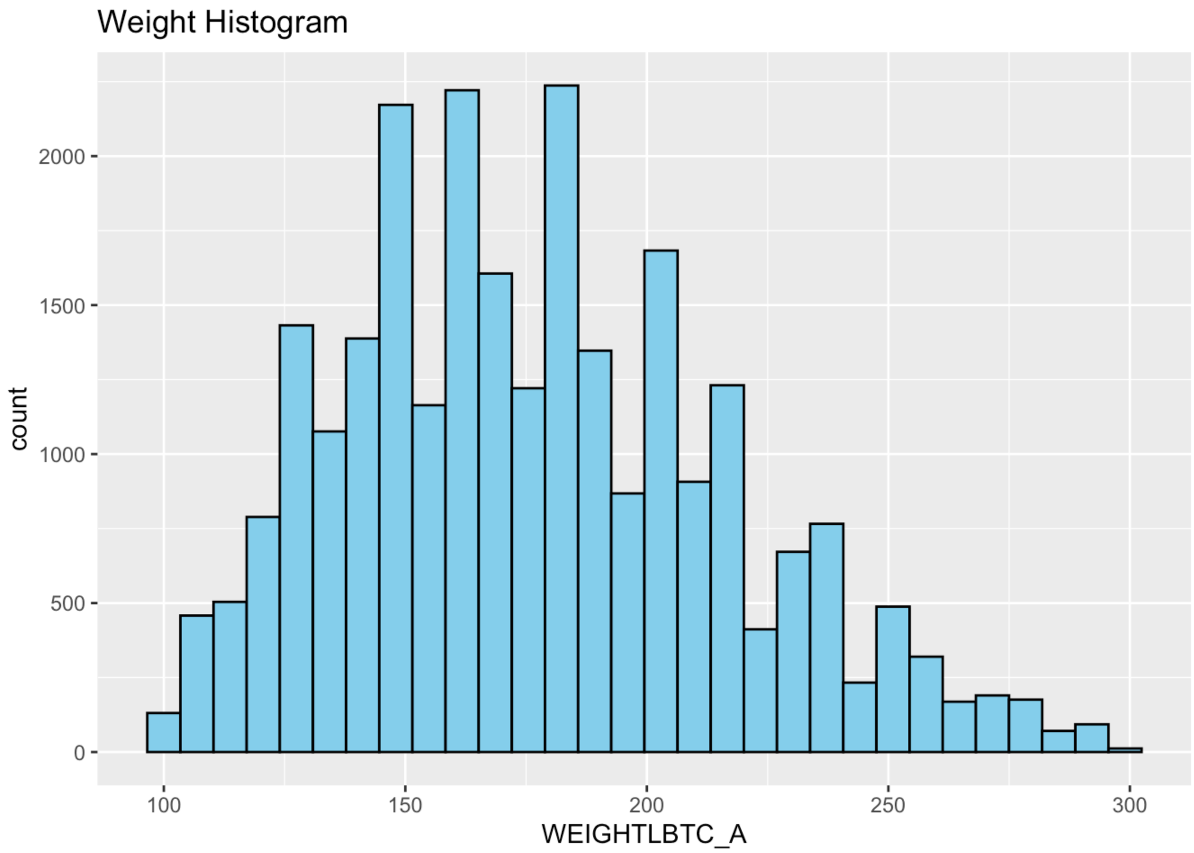


```
### ggplot2 Histograms
ggplot(NHIS_2021_clean, aes(x=AGEP_A)) + geom_histogram(binwidth=5, fill="skyblue", color="black")
+ labs(title="Age Histogram", x="Age")
```



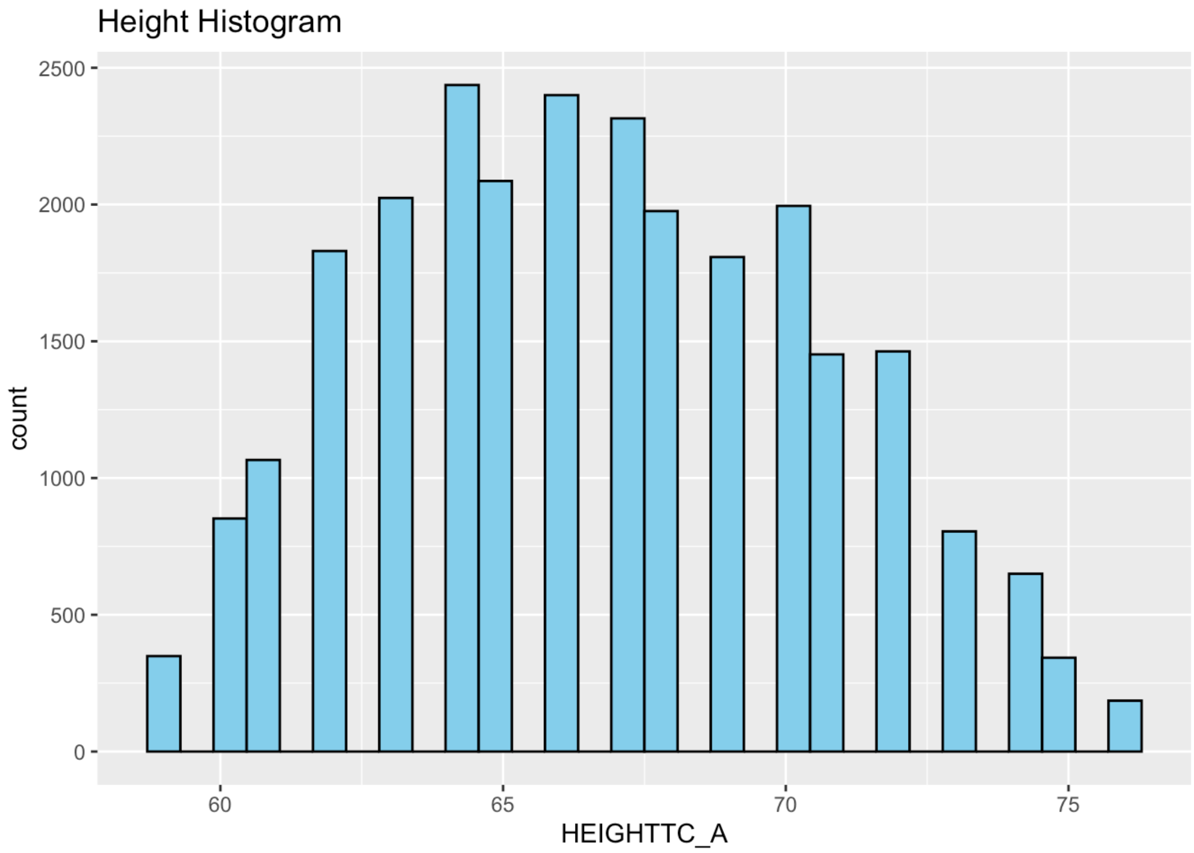
```
ggplot(NHIS_2021_clean, aes(x=WEIGHTLBTC_A)) + geom_histogram(fill="skyblue", color="black") + lab
s(title="Weight Histogram")
```

```
## `stat_bin()` using `bins = 30`. Pick better value `binwidth`.
```



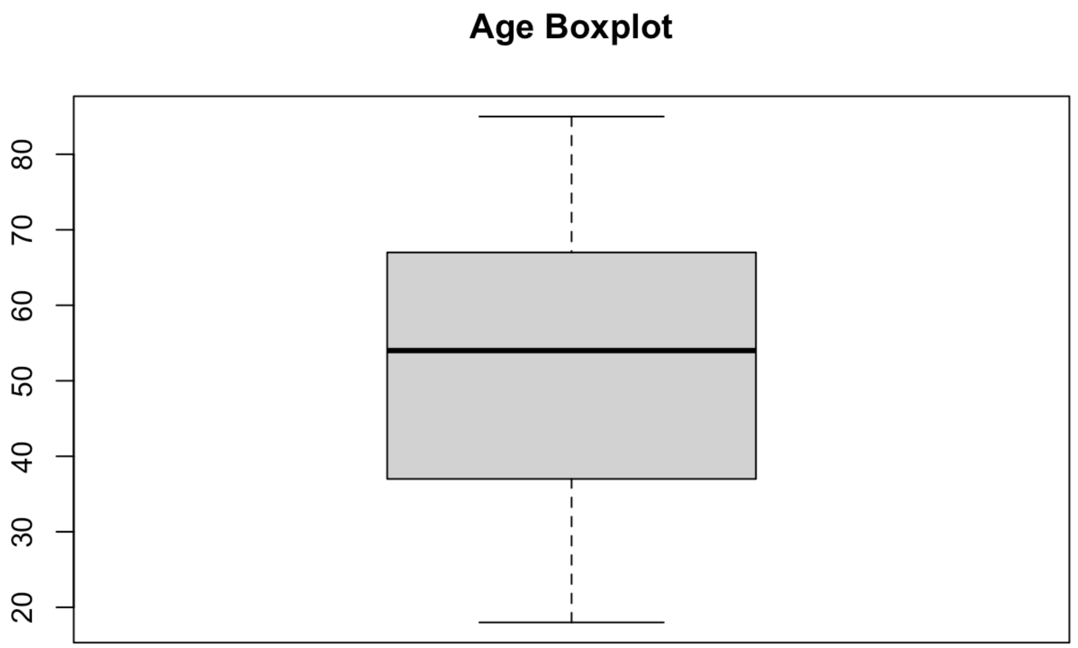
```
ggplot(NHIS_2021_clean, aes(x=HEIGHTTC_A)) + geom_histogram(fill="skyblue", color="black") + labs
(title="Height Histogram")
```

```
## `stat_bin()` using `bins = 30`. Pick better value `binwidth`.
```

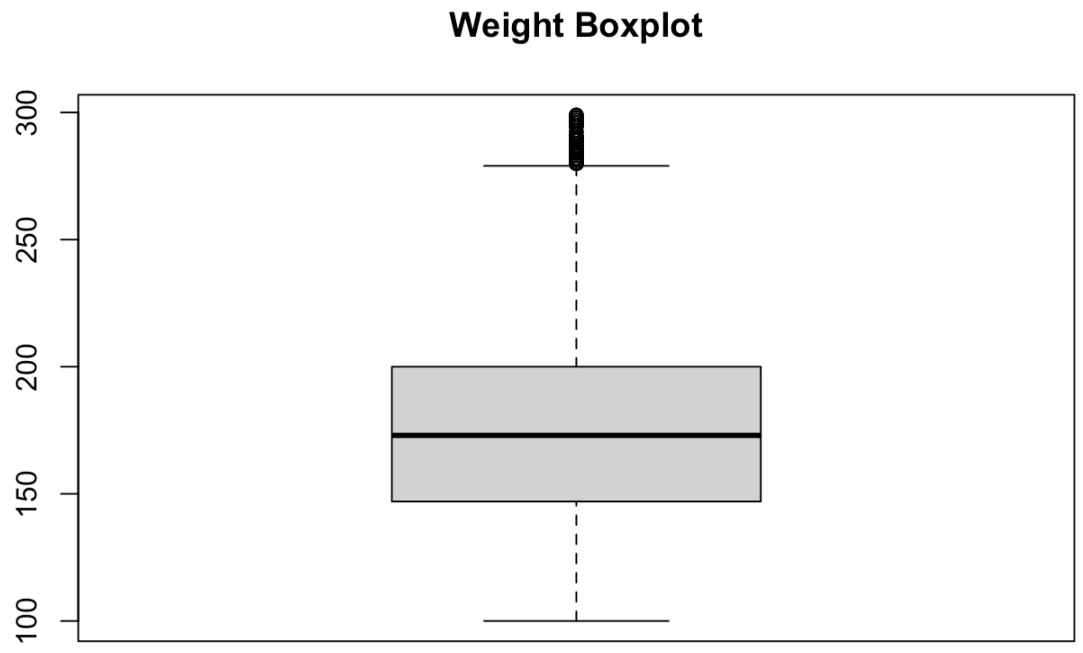


Interpretation:
The sample contains adults across a wide age range indicating that this dataset has a normal distribution for age, with a concentration in middle-aged groups.

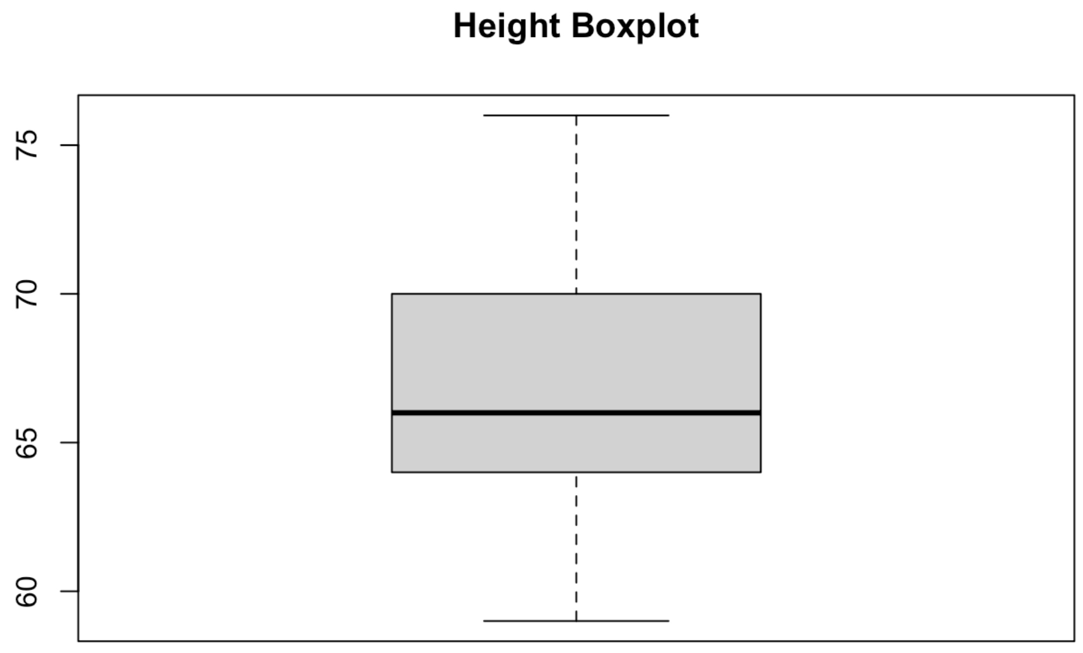
```
#Boxplots Base R
boxplot(NHIS_2021_clean$AGEP_A, main="Age Boxplot")
```



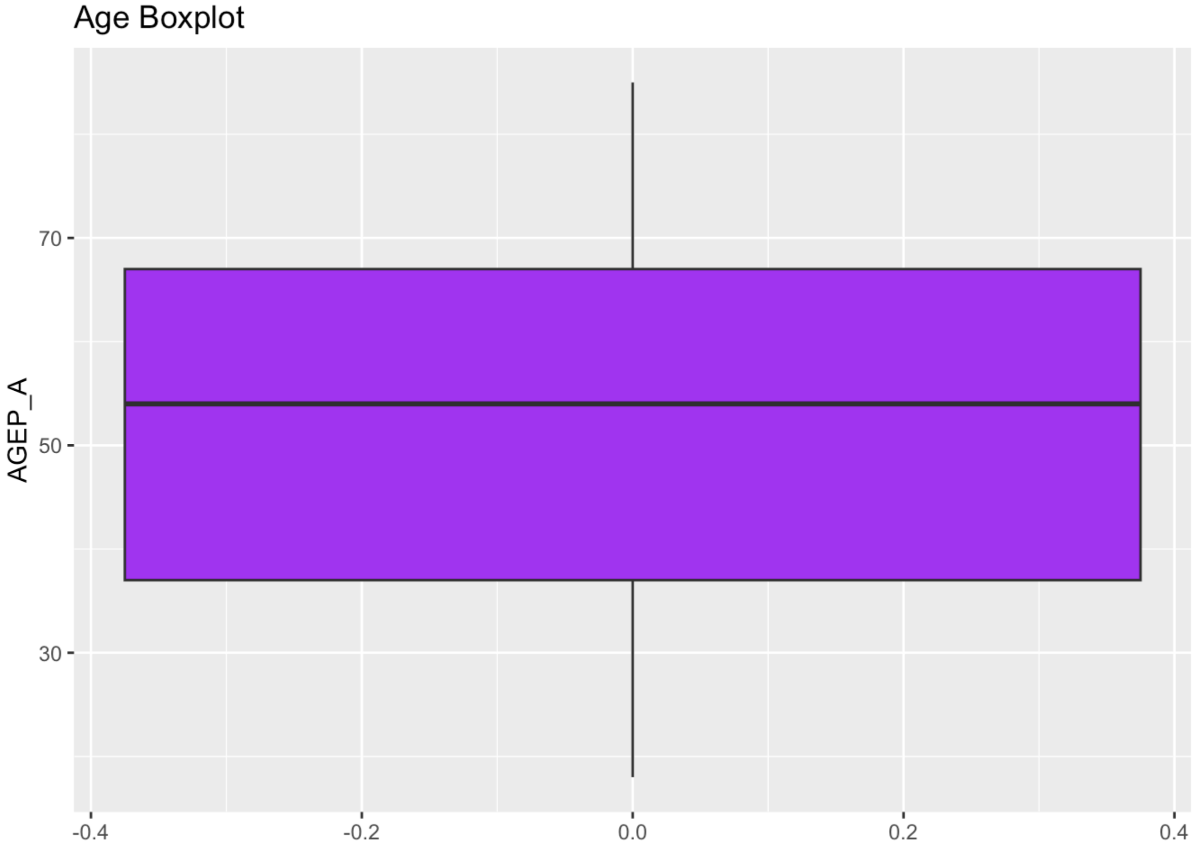
```
boxplot(NHIS_2021_clean$WEIGHTLBTC_A, main="Weight Boxplot")
```



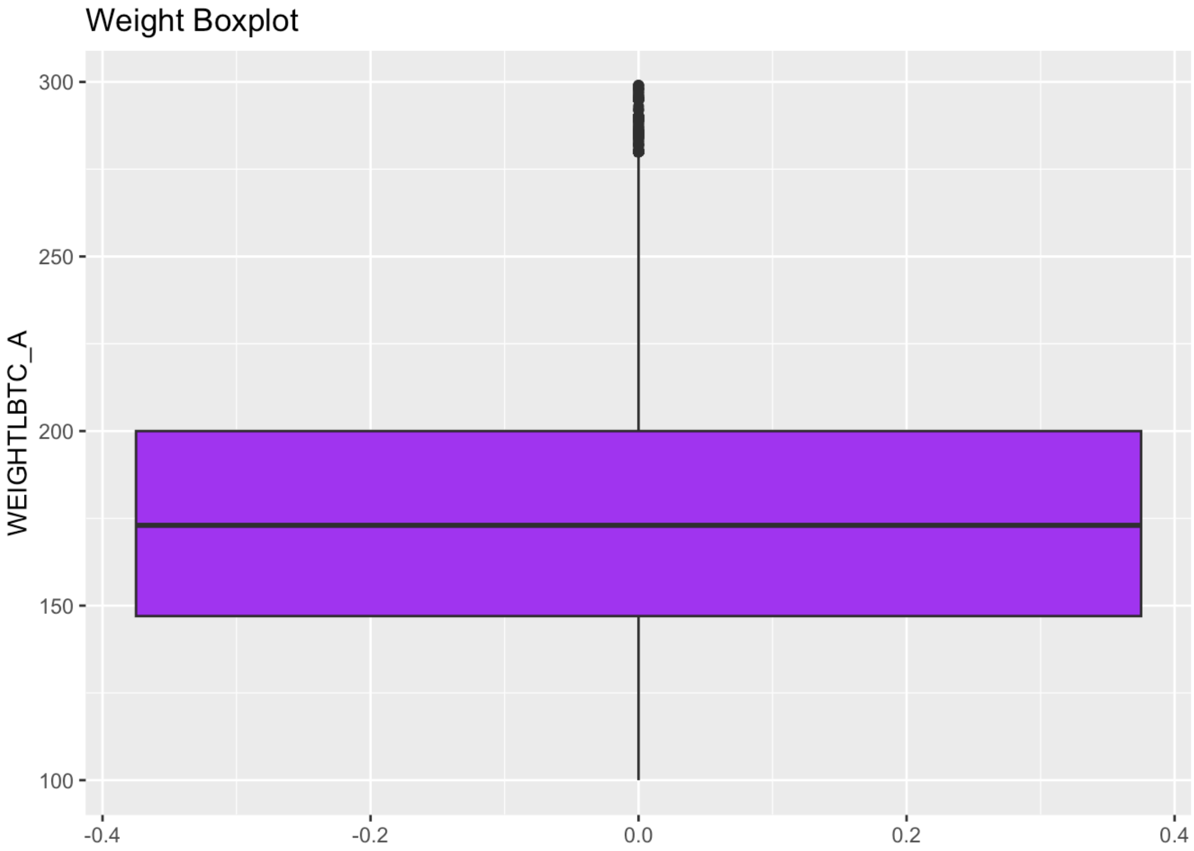
```
boxplot(NHIS_2021_clean$HEIGHTTC_A, main="Height Boxplot")
```



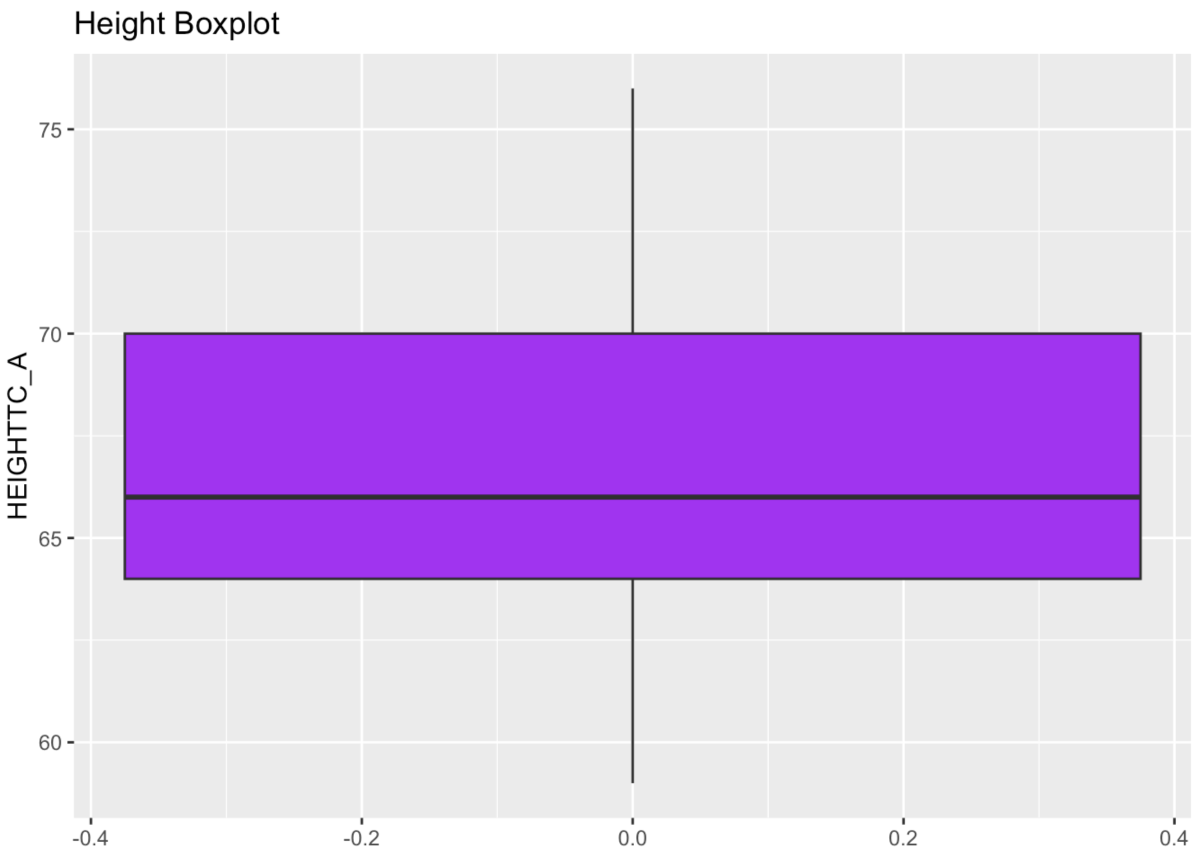
```
#Boxplot ggplot2
ggplot(NHIS_2021_clean, aes(y=AGEP_A)) + geom_boxplot(fill="purple") + labs(title="Age Boxplot")
```



```
ggplot(NHIS_2021_clean, aes(y=WEIGHTLBTC_A)) + geom_boxplot(fill="purple") + labs(title="Weight Bo
xplot")
```



```
ggplot(NHIS_2021_clean, aes(y=HEIGHTTC_A)) + geom_boxplot(fill="purple") + labs(title="Height Boxp
lot")
```



Interpretation:
When looking at the height variable, most participants fall between 65 and 70 inches.

###Qualitative Variables

##Frequency Table

```
table(NHIS_2021_clean$SEX_A)
```

```
##
##     1     2
## 11967 14070
```

```
table(NHIS_2021_clean$HISPALLP_A)
```

```
##
##     1     2     3     4     5     6     7
##  3533 17617  2645  1564   153   196   329
```

```
table(NHIS_2021_clean$EDUCP_A)
```

```
## 
##      less than High School       High School Graduate 
##                       2676                       5765 
##     Some College Education College Graduate or better 
##                       7238                      10358
```

```
table(NHIS_2021_clean$PHSTAT_A)
```

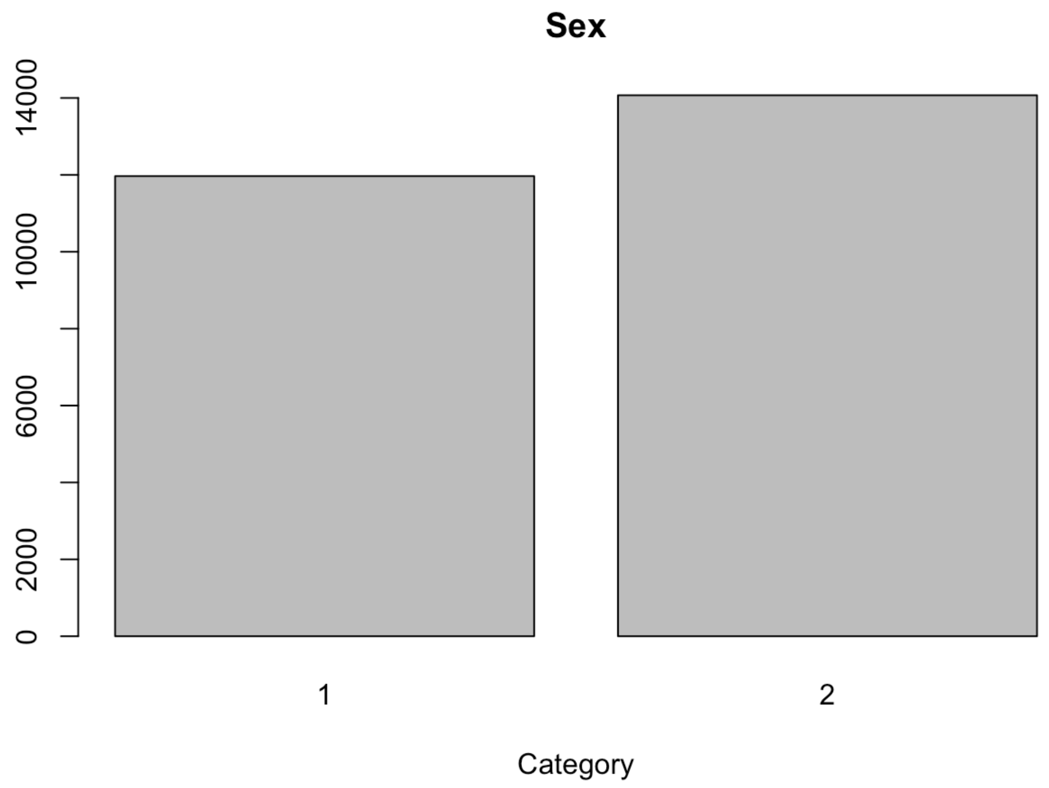
```
## 
##    1    2    3    4    5 
## 6065 9185 7287 2717  783
```

```
table(NHIS_2021_clean$LSATIS4R_A)
```

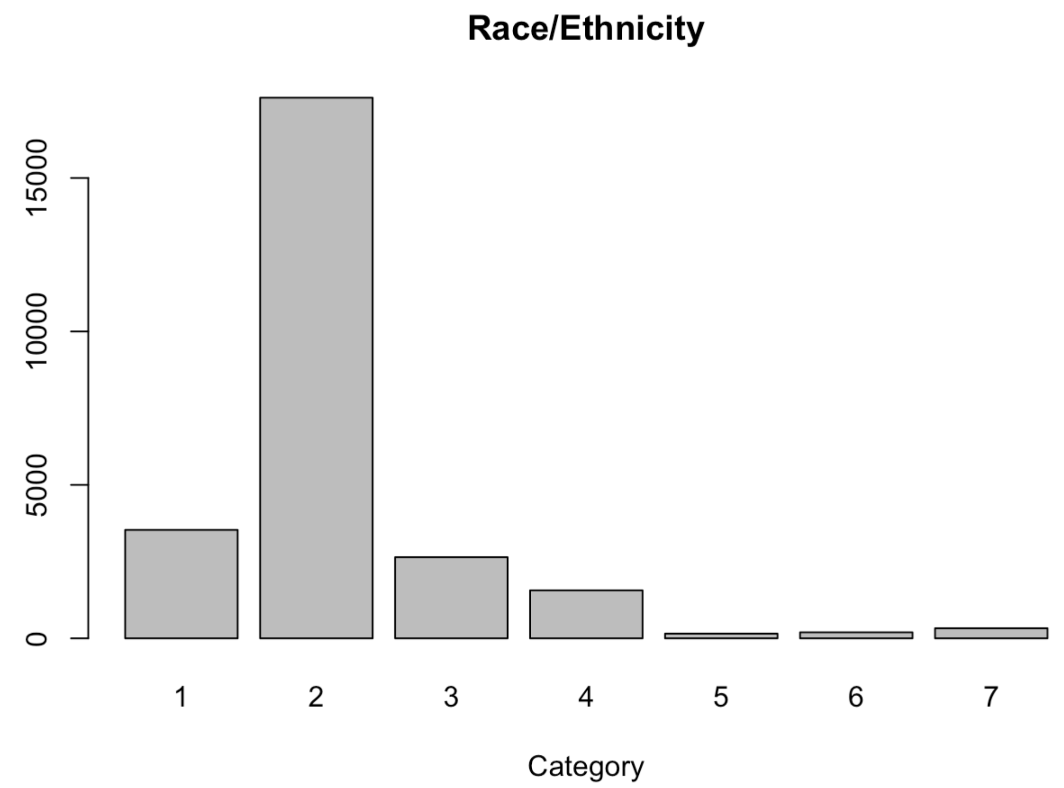
```
## 
##     1     2     3     4 
## 12458 12266  1025   288
```

Interpretation:
Many respondents have at least a high school diploma, with most reporting some college or a college degree at 10,358 participants. There were more females than males within the data, most participants were non hispanic white, had very good health status, and were very satisfied or satisfied with their lives. From a public health standpoint, results indicate that this dataset has higher numbers of participants that could be considered mentally and physically content, and further research could be done to see if any to variables with what could be considered positive results are related to one another.

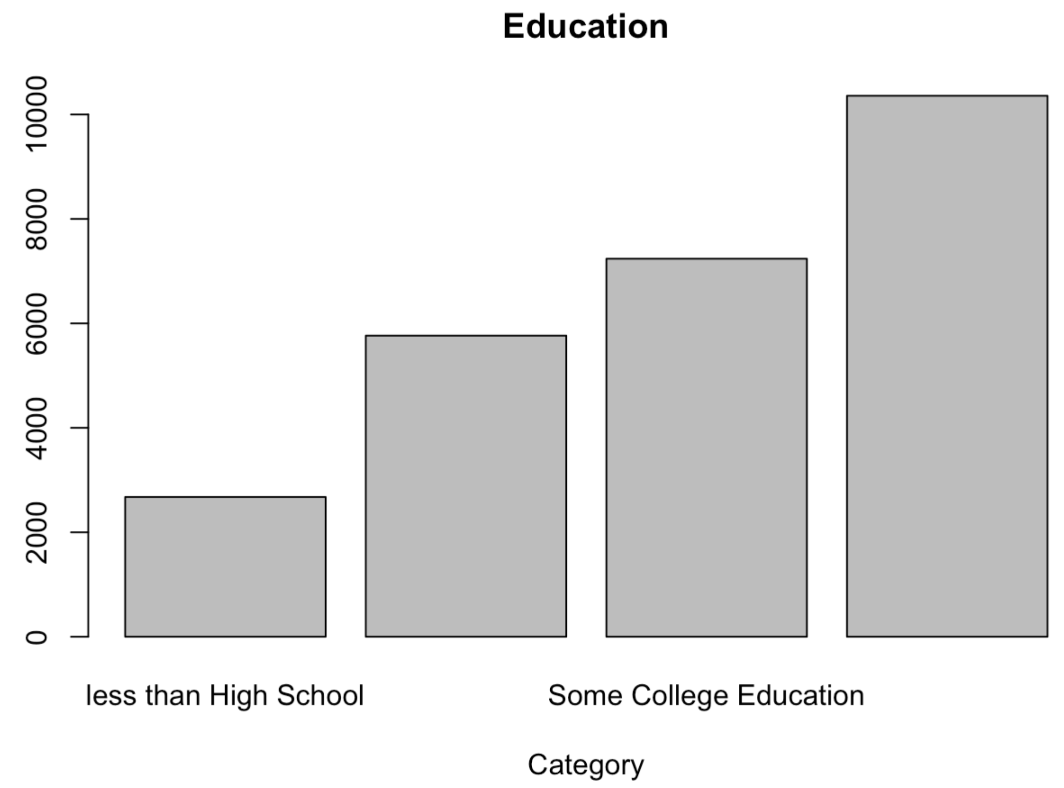
```
## Base R Bar plots for qualitative variables
barplot(table(NHIS_2021_clean$SEX_A), main="Sex", xlab="Category")
```



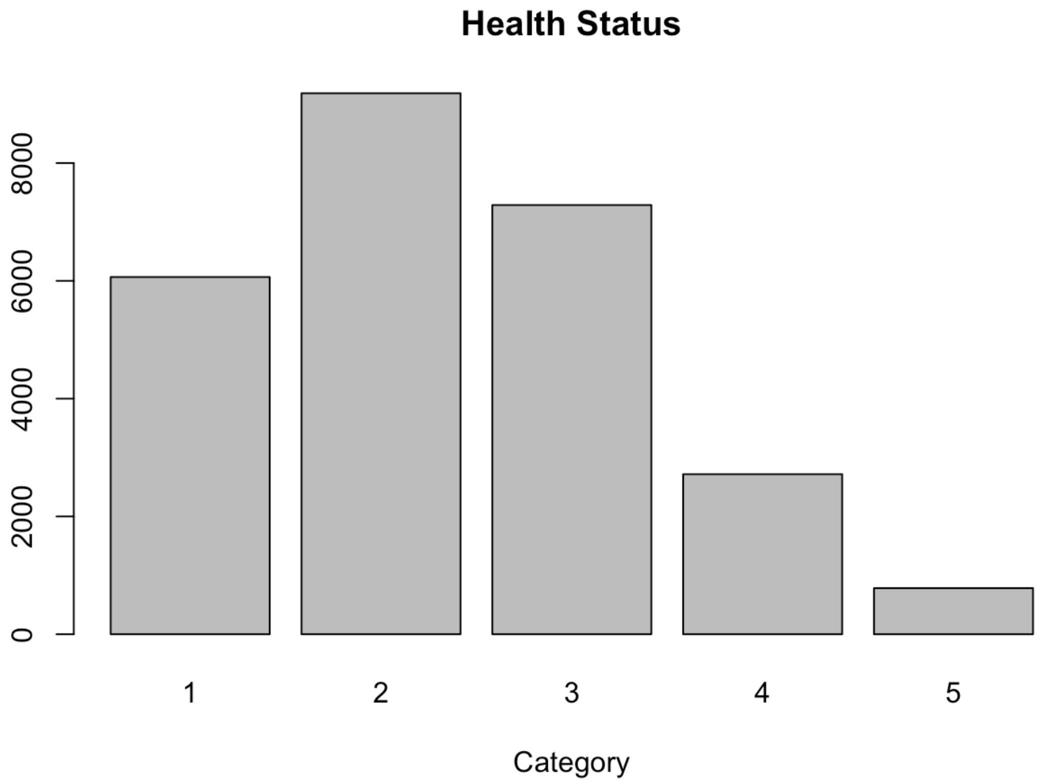
```
barplot(table(NHIS_2021_clean$HISPALLP_A), main="Race/Ethnicity", xlab="Category")
```



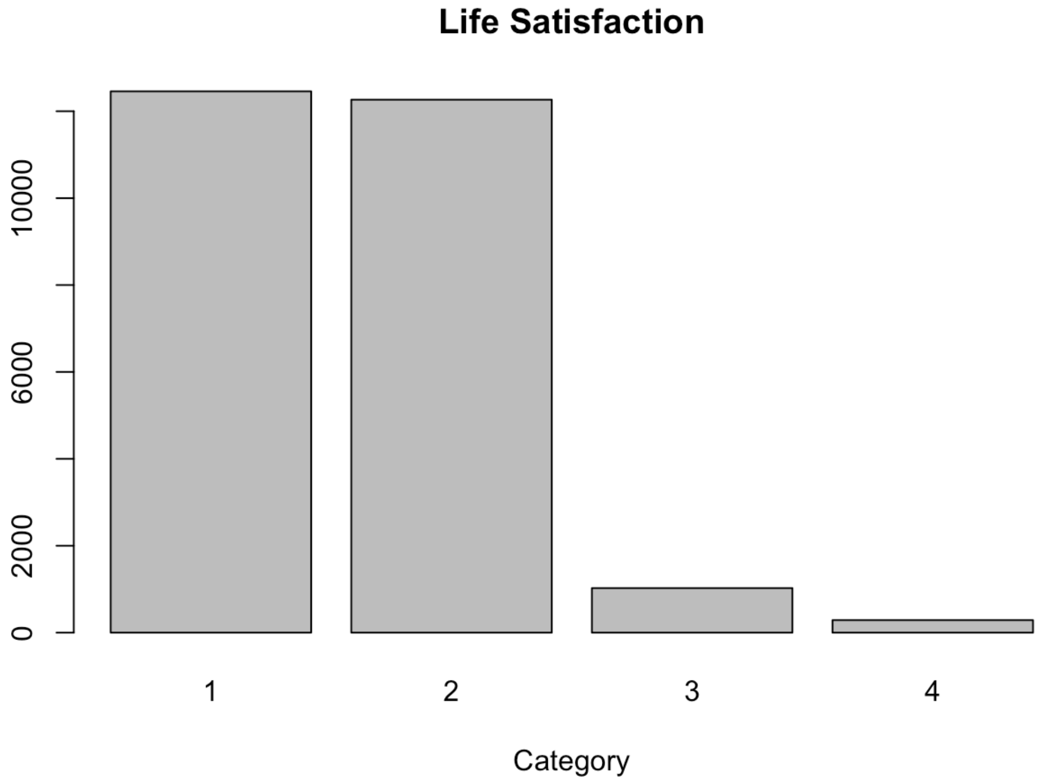
```
barplot(table(NHIS_2021_clean$EDUCP_A), main="Education", xlab="Category")
```



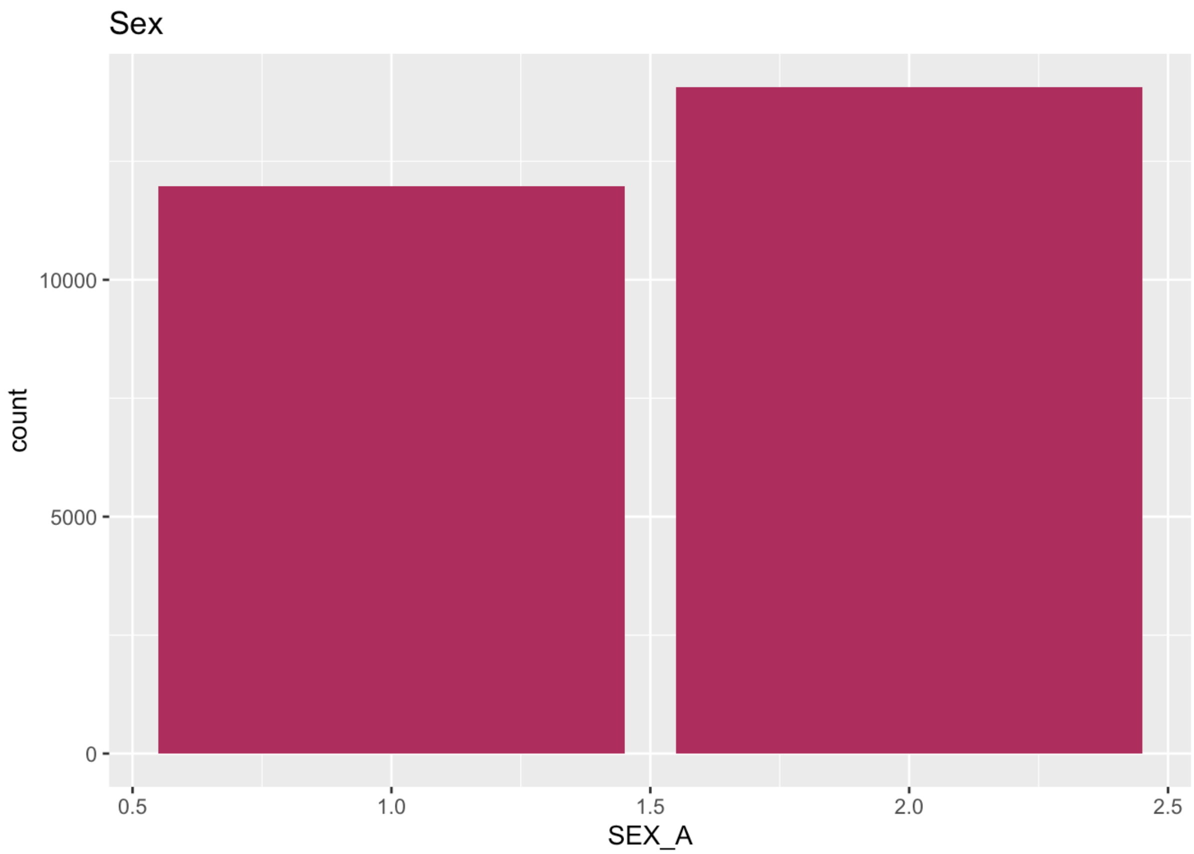
```
barplot(table(NHIS_2021_clean$PHSTAT_A), main="Health Status", xlab="Category")
```



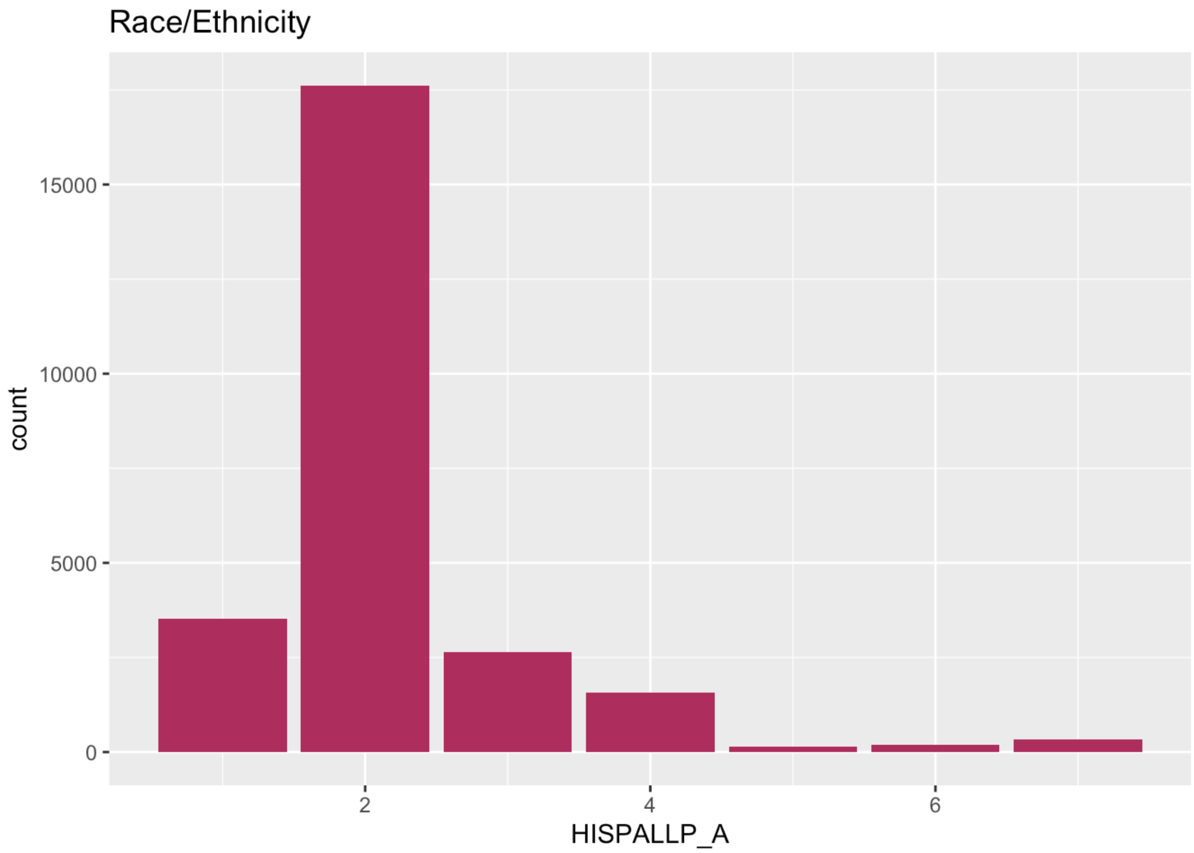
```
barplot(table(NHIS_2021_clean$LSATIS4R_A), main="Life Satisfaction", xlab="Category")
```



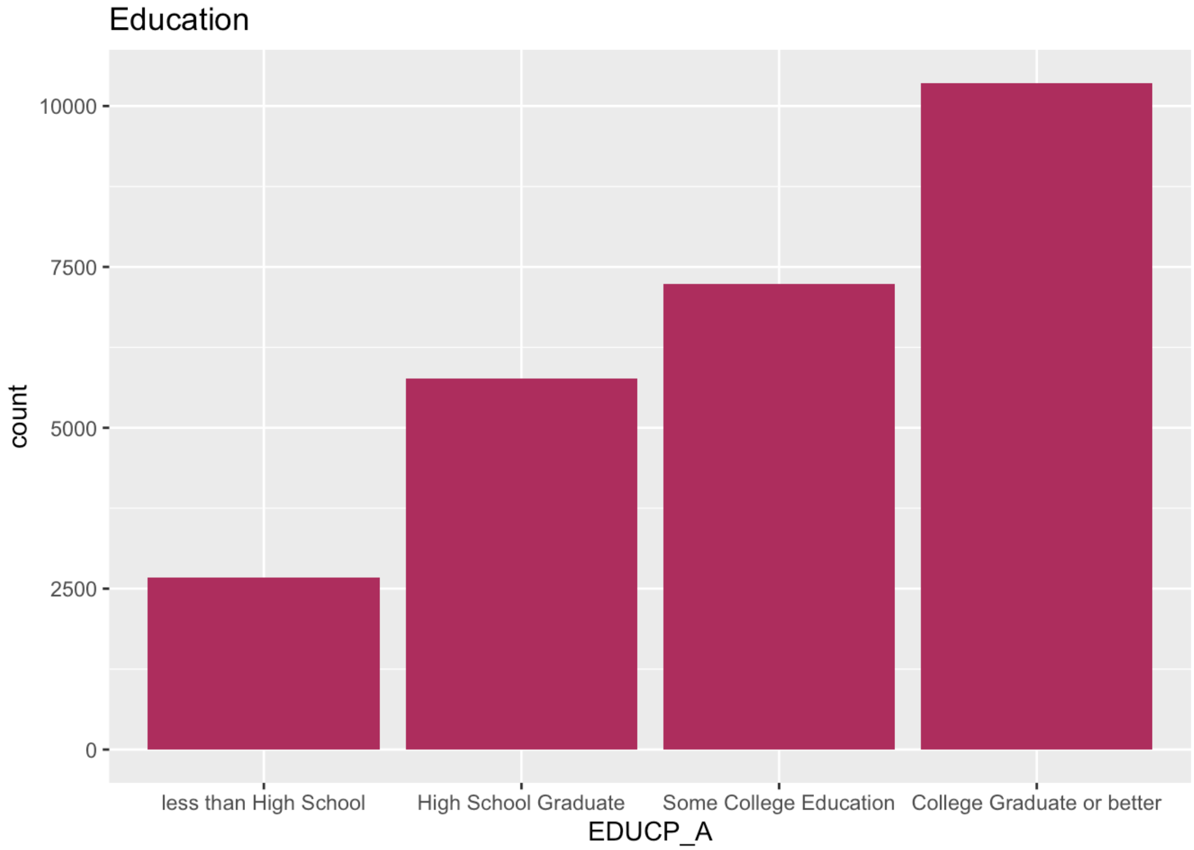
```
##ggplot2 bar plots
ggplot(NHIS_2021_clean, aes(x=SEX_A)) + geom_bar(fill="maroon") + labs(title="Sex")
```



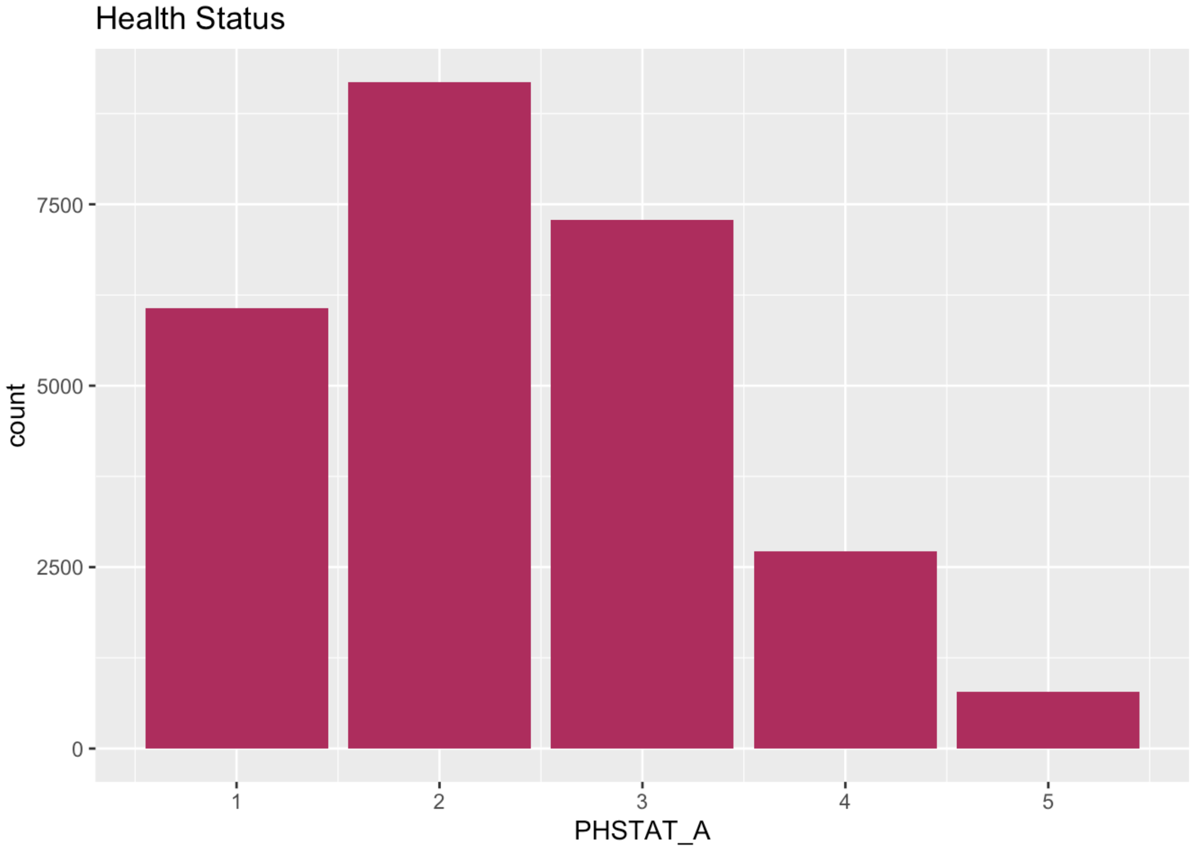
```
ggplot(NHIS_2021_clean, aes(x=HISPALLP_A)) + geom_bar(fill="maroon") + labs(title="Race/Ethnicit
y")
```



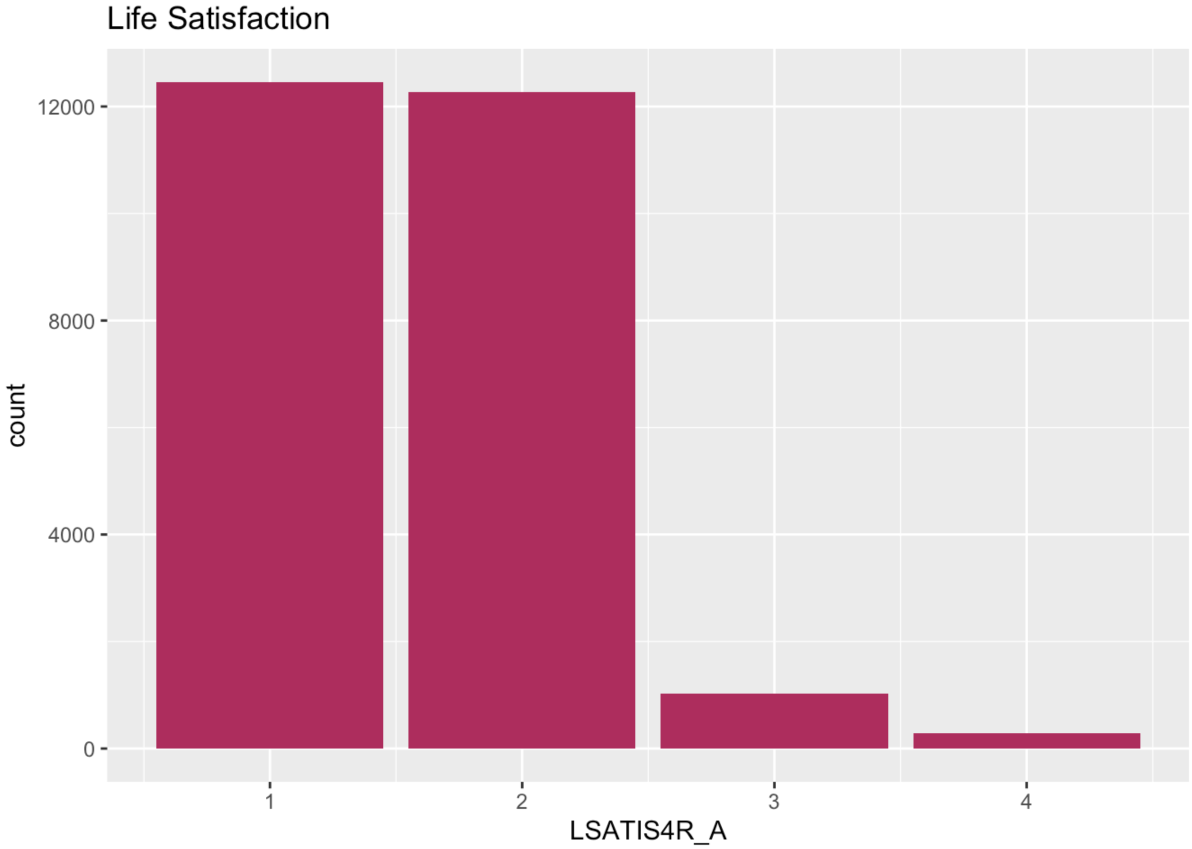
```
ggplot(NHIS_2021_clean, aes(x=EDUCP_A)) + geom_bar(fill="maroon") + labs(title="Education")
```



```
ggplot(NHIS_2021_clean, aes(x=PHSTAT_A)) + geom_bar(fill="maroon") + labs(title="Health Status")
```



```
ggplot(NHIS_2021_clean, aes(x=LSATIS4R_A)) + geom_bar(fill="maroon") + labs(title="Life Satisfacti
on")
```



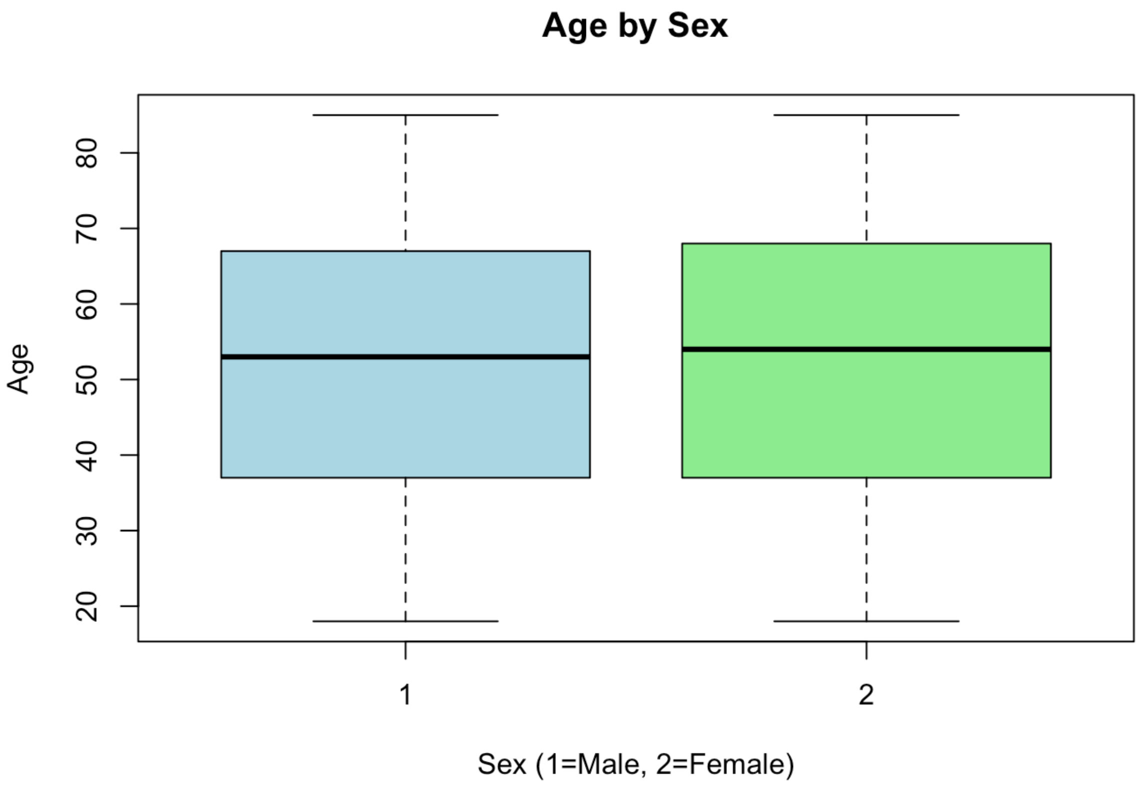
Interpretation:
Bar plots confirm data seen in the frequency tables, allowing for an easier visaulization of any relationships between variables.

#Day 3 Task 2: Bivariate Analysis

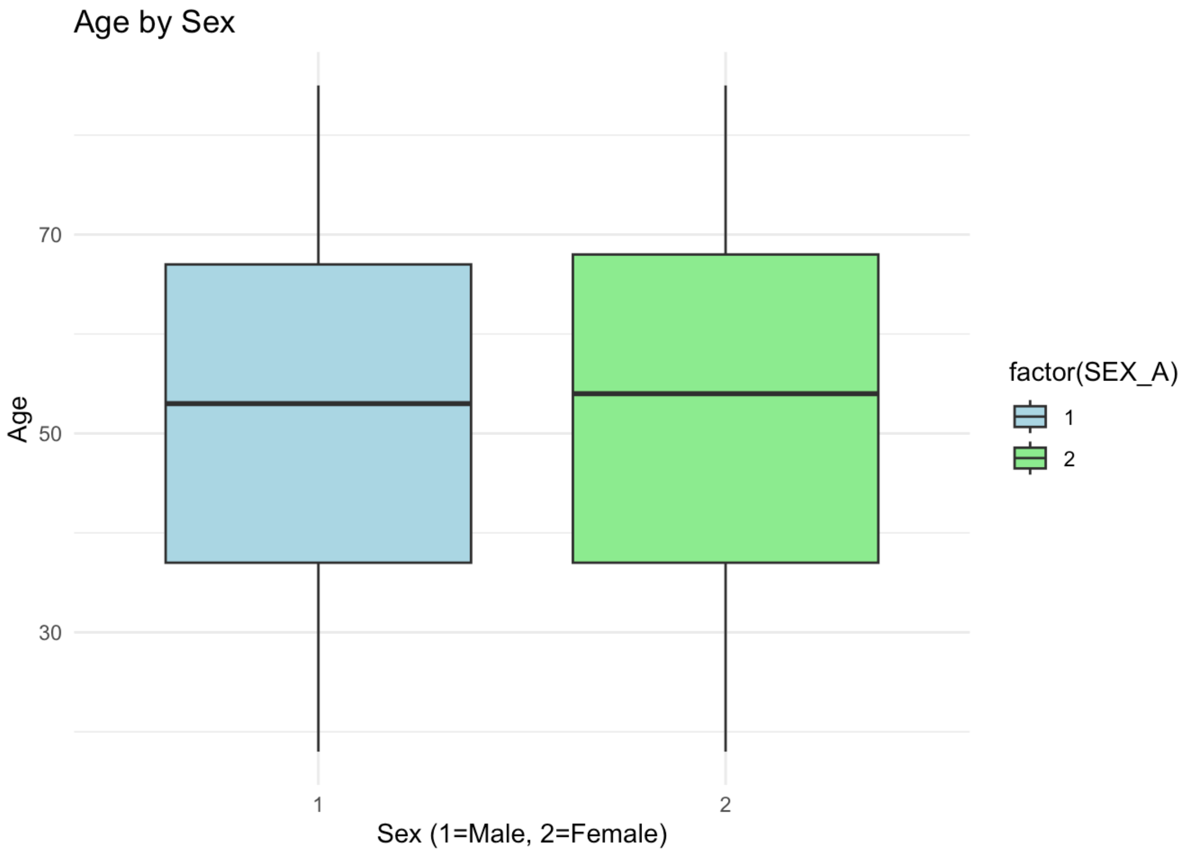
## 1. Quantitative vs Qualitative

```
# Load libraries
library(ggplot2)

## 1A: AGE by SEX_A - Base R
boxplot(AGEP_A ~ SEX_A, data=NHIS_2021_clean,
        main="Age by Sex",
        xlab="Sex (1=Male, 2=Female)",
        ylab="Age",
        col=c("lightblue","lightgreen"))
```

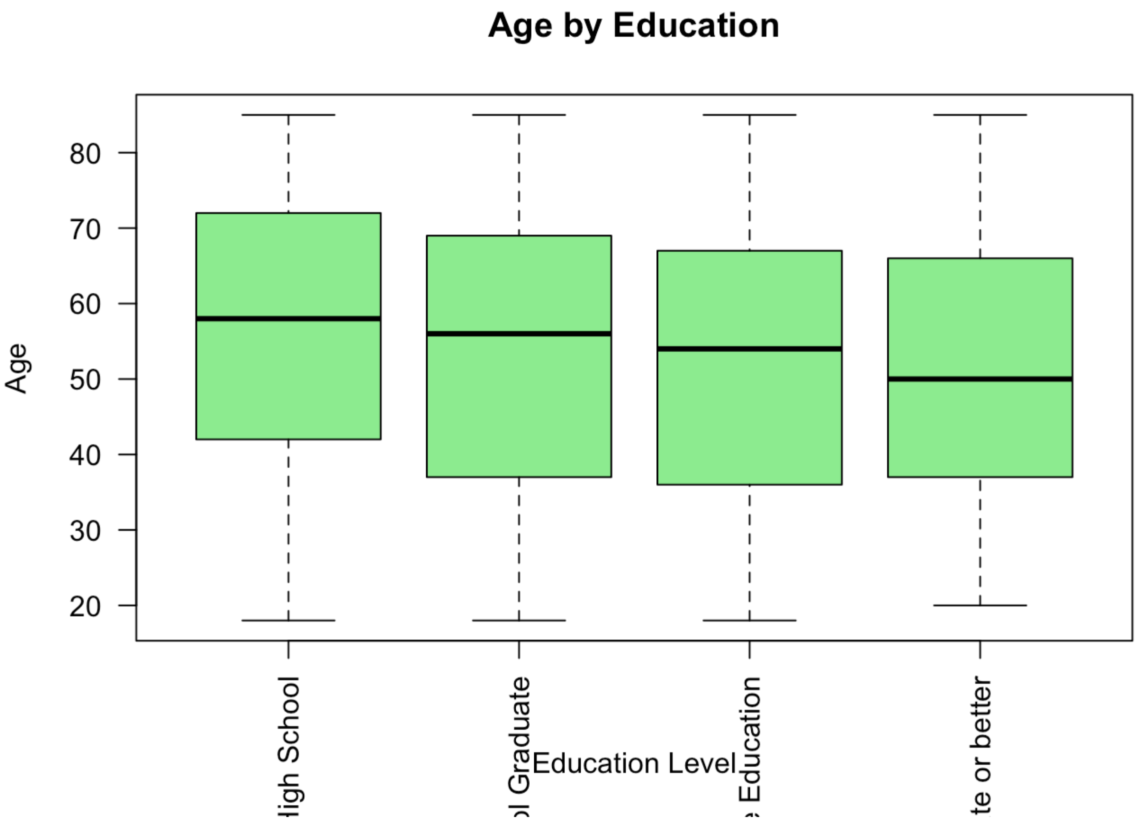


```
# 1B: AGE by SEX_A ggplot2
ggplot(NHIS_2021_clean, aes(x=factor(SEX_A), y=AGEP_A, fill=factor(SEX_A))) +
  geom_boxplot() +
  labs(title="Age by Sex", x="Sex (1=Male, 2=Female)", y="Age") +
  scale_fill_manual(values=c("lightblue","lightgreen")) +
  theme_minimal()
```

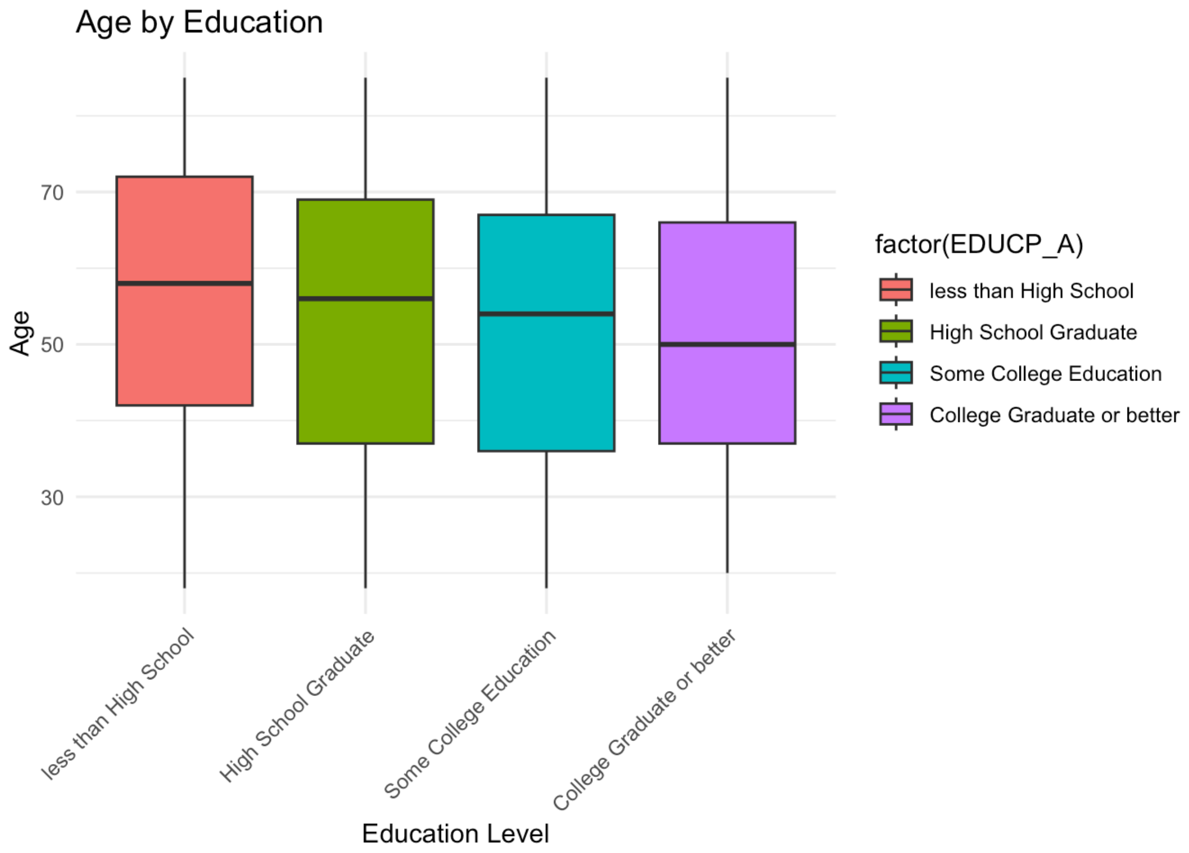


Interpretation:
Within the sample, men and women have a similar distribution looking at age.

```
# 1C Age by EDUCP_A Base R
boxplot(AGEP_A ~ EDUCP_A, data=NHIS_2021_clean,
        main="Age by Education",
        xlab="Education Level",
        ylab="Age",
        col="lightgreen",
        las=2)
```



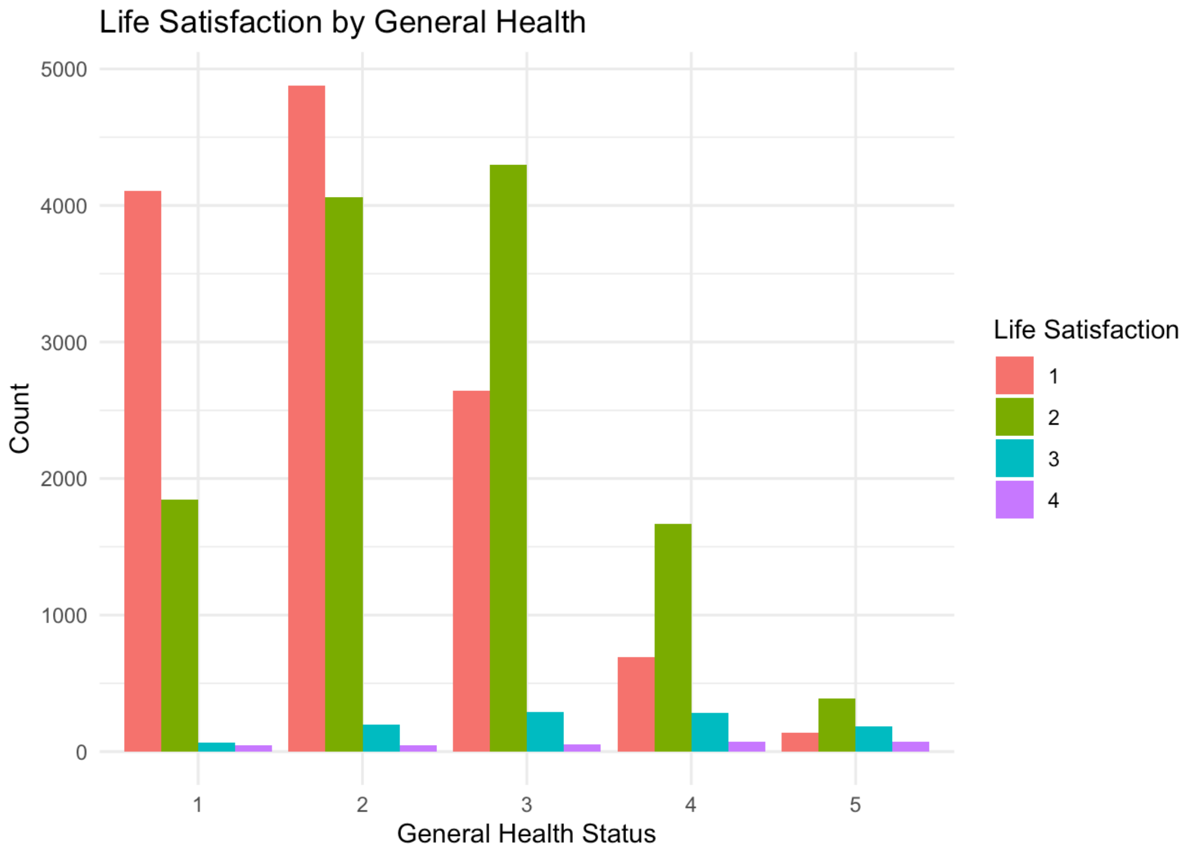
```
# 1D Age by EDUCP_A ggplot2
ggplot(NHIS_2021_clean, aes(x=factor(EDUCP_A), y=AGEP_A, fill=factor(EDUCP_A))) +
  geom_boxplot() +
  labs(title="Age by Education", x="Education Level", y="Age") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle=45, hjust=1))
```



Interpretation:
When looking at education, age seems to decrease with higher levels of education.

2. Qualitative vs Qualitative

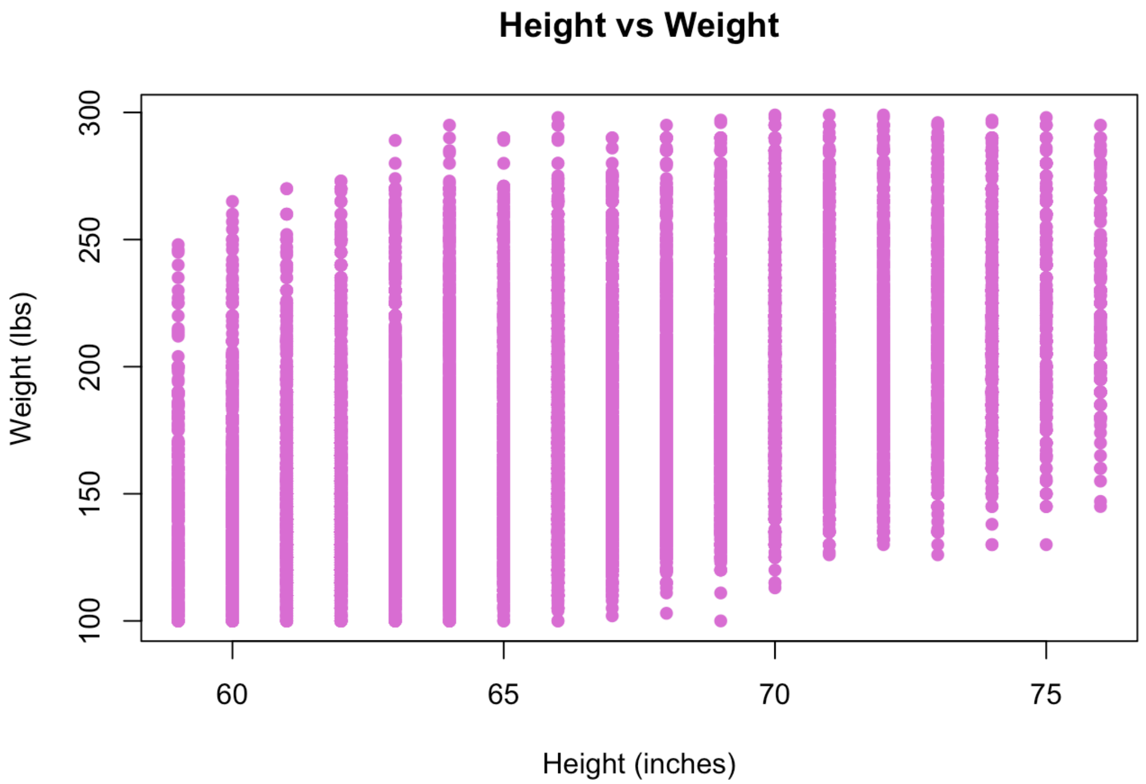
```
# Clustered bar chart ggplot2
ggplot(NHIS_2021_clean, aes(x=factor(PHSTAT_A), fill=factor(LSATIS4R_A))) +
  geom_bar(position="dodge") +
  labs(title="Life Satisfaction by General Health",
       x="General Health Status",
       y="Count",
       fill="Life Satisfaction") +
  theme_minimal()
```



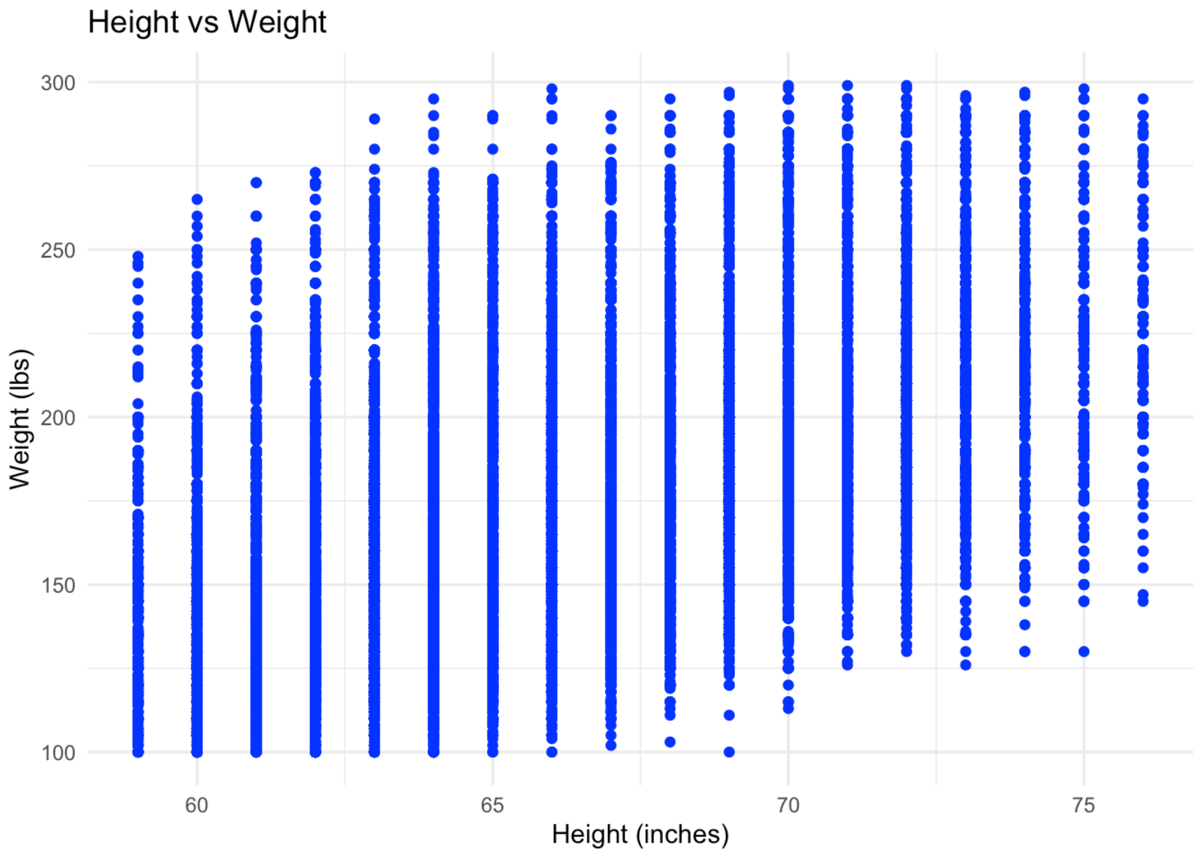
Interpretation:
Respondents with better general health tend to report higher life satisfaction.

3. Quantitative vs Quantitative

```
# 3A: Height vs weight Base R version
plot(NHIS_2021_clean$HEIGHTTC_A, NHIS_2021_clean$WEIGHTLBTC_A,
     main="Height vs Weight",
     xlab="Height (inches)",
     ylab="Weight (lbs)",
     col="orchid", pch=16)
```



```
# 3B Height vs weight ggplot2
ggplot(NHIS_2021_clean, aes(x=HEIGHTTC_A, y=WEIGHTLBTC_A)) +
  geom_point(color="blue") +
  labs(title="Height vs Weight", x="Height (inches)", y="Weight (lbs)") +
  theme_minimal()
```



Interpretation:
This graph shows that lower height is related to smaller weight, while larger height is related to higher weight.

```
# 3C Correlation coefficient
cor_value <- cor(NHIS_2021_clean$HEIGHTTC_A, NHIS_2021_clean$WEIGHTLBTC_A, use="complete.obs")
cat("Correlation coefficient (Height vs Weight):", cor_value, "\n")
```

```
## Correlation coefficient (Height vs Weight): 0.5023037
```

Interpretation:
Height and weight show a strong positive correlation, consistent with expected body-size patterns.

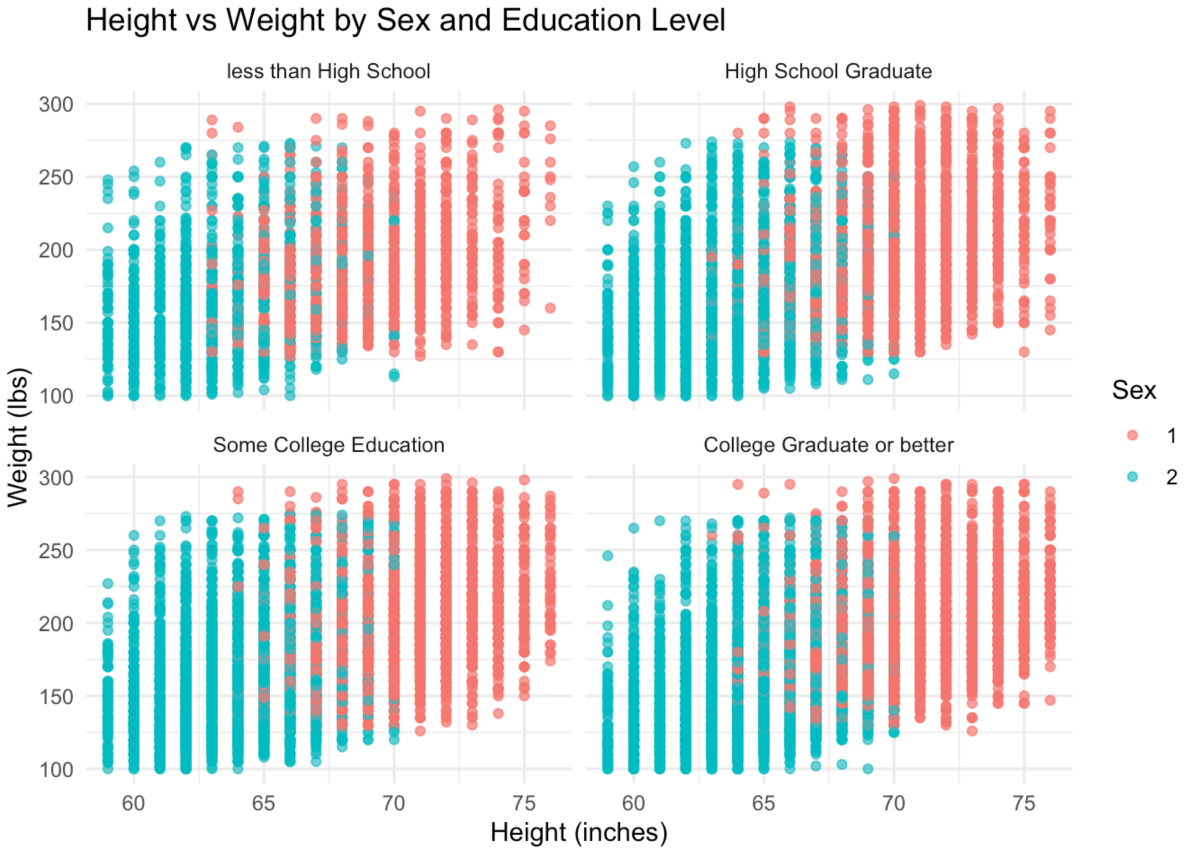
Multivariate Visualization

```
# Load packages
library(ggplot2)
library(psych)
```

```
##
## Attaching package: 'psych'
```

```
## The following objects are masked from 'package:ggplot2':
##
##     %+%, alpha
```

```
##### Task 1: Part 1 Enhancing Scatter Plot (Height vs Weight)
# Colored by SEX_A and faceted by EDUCP_A
ggplot(NHIS_2021_clean, aes(x = HEIGHTTC_A, y = WEIGHTLBTC_A, color = factor(SEX_A))) +
  geom_point(alpha = 0.7) +
  facet_wrap(~ EDUCP_A) +
  labs(
    title = "Height vs Weight by Sex and Education Level",
    x = "Height (inches)",
    y = "Weight (lbs)",
    color = "Sex"
  ) +
  theme_minimal()
```



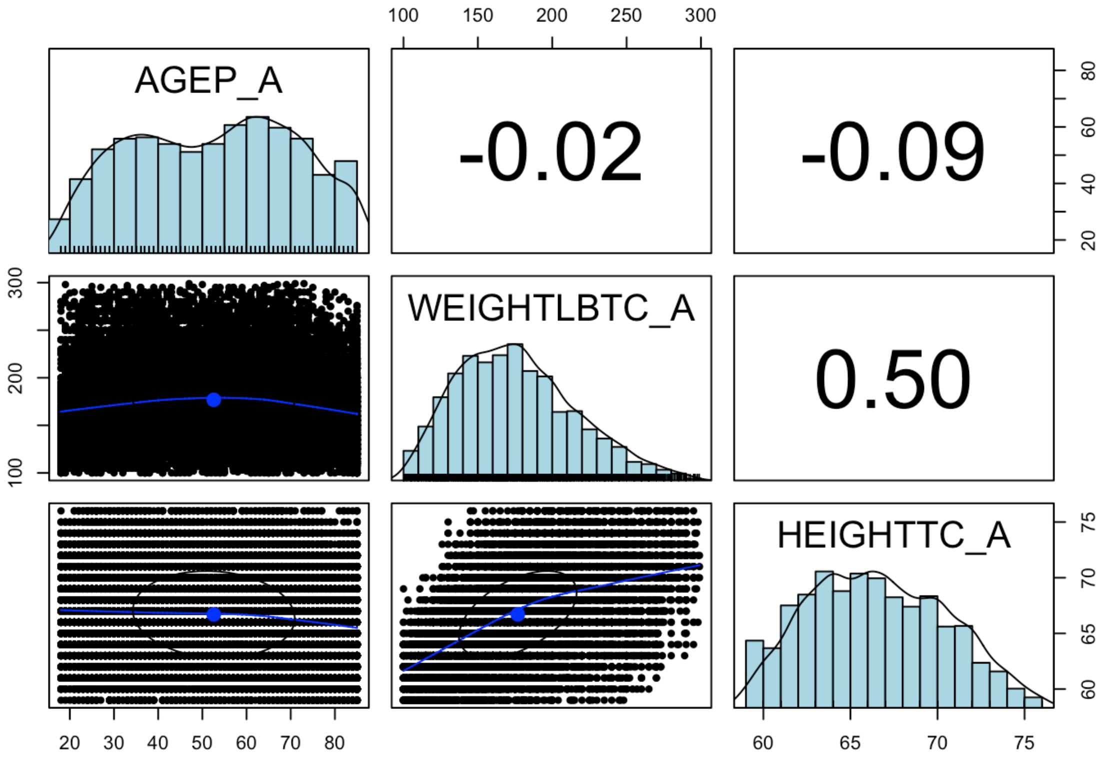
Interpretation:
The height–weight trend is consistent across sexes and education groups, though men tend to weigh more at comparable heights.

Part 2 Correlation Plot Matrix

```
# Variables: Age, Weight, Height

vars_for_corr <- NHIS_2021_clean[, c("AGEP_A", "WEIGHTLBTC_A", "HEIGHTTC_A")]

# Psych package scatter matrix
pairs.panels(
  vars_for_corr,
  method = "pearson",      # method used
  hist.col = "lightblue",  # color of histograms
  density = TRUE,
  ellipses = TRUE
)
```



Interpretation:
Height and weight have the strongest correlation; age has weaker associations but contributes to variation in weight.

Discussion

Our analysis of the 2021 NHIS dataset reveals several clear patterns. Self-rated health is strongly associated with life satisfaction, and the expected positive relationship between height and weight appears in all subgroups. Education shows meaningful differences in age distribution and may relate to health patterns indirectly. Because NHIS is cross-sectional, causal direction cannot be determined.

Conclusion

Overall, the results suggest that demographic factors, education, health status, and well-being are interconnected. Better general health aligns with higher life satisfaction, height and weight show predictable correlations, and education does not drastically change body-size relationships. These findings highlight the value of descriptive and multivariate approaches when analyzing public health survey data.