# hip_replacement_operations

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17/09/2021

## Aim

Plot 'EQ-5D Index' scores (a combination of five key criteria concerning patients' self-reported general health) pre and post a hip replacement operation for different age groups.

## Load packages

We only need the tidyverse for this exercise.

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.4.3

## Warning: package 'ggplot2' was built under R version 4.4.3

## Warning: package 'tibble' was built under R version 4.4.3

## Warning: package 'tidyr' was built under R version 4.4.3

## Warning: package 'readr' was built under R version 4.4.3

## Warning: package 'purrr' was built under R version 4.4.3

## Warning: package 'dplyr' was built under R version 4.4.3

## Warning: package 'stringr' was built under R version 4.4.3

## Warning: package 'forcats' was built under R version 4.4.3

## Warning: package 'lubridate' was built under R version 4.4.3

## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.1     v stringr   1.5.2
## v ggplot2   4.0.0     v tibble    3.3.0
## v lubridate 1.9.4     v tidyr     1.3.1
## v purrr     1.1.0
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(here)
```

```
## Warning: package 'here' was built under R version 4.4.3
```

```
## here() starts at C:/Users/ECliffe ABDN/OneDrive/Documents/IntroHDS/GitHub/Intro2hdsR
```

## Read in data

The data is in the file "Hip Replacement CCG 1819.csv", and it contains patient reported outcomes for hip replacement procedures, from April 2018 to March 2019. It was downloaded from https://digital.nhs.uk/data-and-information/publications/statistical/patient-reported-outcome-measures-proms/for-hip-and-knee-replacement-procedures-april-2018-to-march-2019 We also have the data dictionary for this dataset in "proms_data_dictionary.pdf".

```
hip_data <- read_csv(here("./Inputs/Hip Replacement CCG 1819.csv"))
```

```
## Rows: 28920 Columns: 81
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (5): Provider Code, Procedure, Year, Age Band, Gender
## dbl (76): Revision Flag, Pre-Op Q Assisted, Pre-Op Q Assisted By, Pre-Op Q S...
##
## 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.
```

```
head(hip_data)
```

```
## # A tibble: 6 x 81
##   `Provider Code` Procedure       `Revision Flag` Year    `Age Band` Gender
##   <chr>           <chr>                     <dbl> <chr>   <chr>      <chr>
## 1 00C             Hip Replacement               0 2018/19 *          *
## 2 00C             Hip Replacement               0 2018/19 *          *
## 3 00C             Hip Replacement               1 2018/19 *          *
## 4 00C             Hip Replacement               1 2018/19 *          *
## 5 00C             Hip Replacement               0 2018/19 *          *
## 6 00C             Hip Replacement               0 2018/19 *          *
## # i 75 more variables: `Pre-Op Q Assisted` <dbl>, `Pre-Op Q Assisted By` <dbl>,
## #   `Pre-Op Q Symptom Period` <dbl>, `Pre-Op Q Previous Surgery` <dbl>,
## #   `Pre-Op Q Living Arrangements` <dbl>, `Pre-Op Q Disability` <dbl>,
## #   `Heart Disease` <dbl>, `High Bp` <dbl>, Stroke <dbl>, Circulation <dbl>,
## #   `Lung Disease` <dbl>, Diabetes <dbl>, `Kidney Disease` <dbl>,
## #   `Nervous System` <dbl>, `Liver Disease` <dbl>, Cancer <dbl>,
## #   Depression <dbl>, Arthritis <dbl>, `Pre-Op Q Mobility` <dbl>, ...
```

## Prepare the data

This includes three steps: inspecting the data, selecting only the variables we want, and dealing with missing values. (In more complicated projects we might also need to join datasets, change data types, etc.)

```
glimpse(hip_data)
```

```
## Rows: 28,920
## Columns: 81
## $ `Provider Code`                          <chr> "00C", "00C", "00C", ~
## $ Procedure                                <chr> "Hip Replacement", "H~
## $ `Revision Flag`                          <dbl> 0, 0, 1, 1, 0, 0, 0, ~
## $ Year                                     <chr> "2018/19", "2018/19",~
## $ `Age Band`                               <chr> "*", "*", "*", "*", "~
## $ Gender                                   <chr> "*", "*", "*", "*", "~
## $ `Pre-Op Q Assisted`                      <dbl> 2, 2, 1, 2, 2, 2, 2, ~
## $ `Pre-Op Q Assisted By`                   <dbl> 0, 0, 0, 0, 0, 0, 0, ~
## $ `Pre-Op Q Symptom Period`                <dbl> 4, 2, 4, 1, 2, 1, 1, ~
## $ `Pre-Op Q Previous Surgery`              <dbl> 2, 1, 1, 1, 2, 2, 1, ~
## $ `Pre-Op Q Living Arrangements`           <dbl> 1, 1, 2, 2, 1, 2, 1, ~
## $ `Pre-Op Q Disability`                    <dbl> 9, 1, 1, 1, 2, 1, 2, ~
## $ `Heart Disease`                          <dbl> 9, 9, 9, 9, 9, 9, 9, ~
## $ `High Bp`                                <dbl> 9, 9, 9, 9, 9, 1, 9, ~
## $ Stroke                                   <dbl> 9, 9, 9, 9, 9, 9, 1, ~
## $ Circulation                              <dbl> 9, 9, 9, 9, 1, 9, 9, ~
## $ `Lung Disease`                           <dbl> 9, 9, 9, 9, 9, 9, 9, ~
## $ Diabetes                                 <dbl> 9, 9, 9, 9, 9, 9, 9, ~
## $ `Kidney Disease`                         <dbl> 9, 9, 9, 9, 9, 1, 9, ~
## $ `Nervous System`                         <dbl> 9, 9, 9, 9, 9, 9, 9, ~
## $ `Liver Disease`                          <dbl> 9, 9, 9, 9, 9, 9, 1, ~
## $ Cancer                                   <dbl> 9, 9, 9, 9, 9, 9, 1, ~
## $ Depression                               <dbl> 9, 9, 9, 1, 9, 9, 9, ~
## $ Arthritis                                <dbl> 9, 1, 1, 1, 1, 1, 9, ~
## $ `Pre-Op Q Mobility`                      <dbl> 2, 2, 9, 2, 2, 2, 2, ~
## $ `Pre-Op Q Self-Care`                     <dbl> 1, 2, 9, 1, 2, 1, 1, ~
## $ `Pre-Op Q Activity`                      <dbl> 9, 3, 9, 3, 3, 2, 2, ~
## $ `Pre-Op Q Discomfort`                    <dbl> 9, 3, 9, 3, 3, 3, 2, ~
## $ `Pre-Op Q Anxiety`                       <dbl> 9, 1, 9, 2, 3, 1, 1, ~
## $ `Pre-Op Q EQ5D Index Profile`            <dbl> 21999, 22331, 99999, ~
## $ `Pre-Op Q EQ5D Index`                    <dbl> NA, -0.003, NA, 0.030~
## $ `Post-Op Q Assisted`                     <dbl> 2, 2, 1, 2, 2, 2, 1, ~
## $ `Post-Op Q Assisted By`                  <dbl> 9, 9, 1, 9, 9, 9, 1, ~
## $ `Post-Op Q Living Arrangements`          <dbl> 1, 1, 2, 2, 1, 2, 1, ~
## $ `Post-Op Q Disability`                   <dbl> 2, 9, 1, 2, 1, 2, 2, ~
## $ `Post-Op Q Mobility`                     <dbl> 2, 9, 2, 1, 2, 2, 1, ~
## $ `Post-Op Q Self-Care`                    <dbl> 2, 1, 2, 1, 1, 1, 1, ~
## $ `Post-Op Q Activity`                     <dbl> 2, 9, 3, 1, 2, 2, 1, ~
## $ `Post-Op Q Discomfort`                   <dbl> 2, 1, 3, 2, 2, 2, 1, ~
## $ `Post-Op Q Anxiety`                      <dbl> 2, 1, 2, 1, 2, 1, 1, ~
## $ `Post-Op Q Satisfaction`                 <dbl> 2, 3, 2, 1, 3, 1, 1, ~
## $ `Post-Op Q Sucess`                       <dbl> 1, 1, 1, 1, 2, 2, 1, ~
## $ `Post-Op Q Allergy`                      <dbl> 2, 2, 2, 2, 2, 9, 9, ~
## $ `Post-Op Q Bleeding`                     <dbl> 2, 2, 2, 2, 2, 9, 9, ~
## $ `Post-Op Q Wound`                        <dbl> 2, 2, 1, 2, 2, 9, 9, ~
## $ `Post-Op Q Urine`                        <dbl> 2, 2, 2, 2, 2, 1, 9, ~
## $ `Post-Op Q Further Surgery`              <dbl> 2, 2, 1, 2, 2, 2, 2, ~
## $ `Post-Op Q Readmitted`                   <dbl> 2, 2, 1, 2, 2, 2, 2, ~
## $ `Post-Op Q EQ5D Index Profile`           <dbl> 22222, 91911, 22332, ~
```

```
## $ `Post-Op Q EQ5D Index`                              <dbl> 0.516, NA, -0.074, 0.~
## $ `Hip Replacement EQ5D Index Post-Op Q Predicted`    <dbl> NA, NA, NA, 0.5154424~
## $ `Pre-Op Q EQ VAS`                                   <dbl> 999, 999, 999, 50, 30~
## $ `Post-Op Q EQ VAS`                                  <dbl> 70, 999, 80, 90, 70, ~
## $ `Hip Replacement EQ VAS Post-Op Q Predicted`        <dbl> NA, NA, NA, 60.05266,~
## $ `Hip Replacement Pre-Op Q Pain`                     <dbl> 1, 0, 0, 0, 0, 0, 1, ~
## $ `Hip Replacement Pre-Op Q Sudden Pain`              <dbl> 0, 1, 0, 0, 0, 1, 4, ~
## $ `Hip Replacement Pre-Op Q Night Pain`               <dbl> 2, 0, 1, 0, 0, 1, 1, ~
## $ `Hip Replacement Pre-Op Q Washing`                  <dbl> 3, 1, 1, 2, 2, 4, 4, ~
## $ `Hip Replacement Pre-Op Q Transport`                <dbl> 2, 1, 1, 0, 1, 2, 2, ~
## $ `Hip Replacement Pre-Op Q Dressing`                 <dbl> 1, 0, 1, 0, 1, 4, 2, ~
## $ `Hip Replacement Pre-Op Q Shopping`                 <dbl> 3, 2, 0, 0, 0, 0, 3, ~
## $ `Hip Replacement Pre-Op Q Walking`                  <dbl> 2, 0, 1, 1, 1, 3, 3, ~
## $ `Hip Replacement Pre-Op Q Limping`                  <dbl> 2, 0, 0, 1, 0, 0, 0, ~
## $ `Hip Replacement Pre-Op Q Stairs`                   <dbl> 2, 1, 1, 1, 1, 2, 4, ~
## $ `Hip Replacement Pre-Op Q Standing`                 <dbl> 1, 1, 1, 2, 1, 1, 4, ~
## $ `Hip Replacement Pre-Op Q Work`                     <dbl> 1, 1, 0, 1, 0, 0, 4, ~
## $ `Hip Replacement Pre-Op Q Score`                    <dbl> 20, 8, 7, 8, 7, 18, 3~
## $ `Hip Replacement Post-Op Q Pain`                    <dbl> 3, 4, 2, 2, 4, 2, 2, ~
## $ `Hip Replacement Post-Op Q Sudden Pain`             <dbl> 4, 4, 4, 2, 2, 2, 4, ~
## $ `Hip Replacement Post-Op Q Night Pain`              <dbl> 4, 4, 4, 1, 4, 2, 4, ~
## $ `Hip Replacement Post-Op Q Washing`                 <dbl> 4, 3, 3, 4, 3, 4, 4, ~
## $ `Hip Replacement Post-Op Q Transport`               <dbl> 4, 4, 2, 3, 3, 2, 4, ~
## $ `Hip Replacement Post-Op Q Dressing`                <dbl> 2, 4, 3, 3, 4, 4, 3, ~
## $ `Hip Replacement Post-Op Q Shopping`                <dbl> 4, 2, 0, 3, 2, 0, 4, ~
## $ `Hip Replacement Post-Op Q Walking`                 <dbl> 4, 3, 1, 4, 3, 2, 4, ~
## $ `Hip Replacement Post-Op Q Limping`                 <dbl> 3, 1, 1, 4, 2, 0, 3, ~
## $ `Hip Replacement Post-Op Q Stairs`                  <dbl> 4, 1, 1, 3, 2, 4, 4, ~
## $ `Hip Replacement Post-Op Q Standing`                <dbl> 3, 4, 3, 3, 4, 2, 4, ~
## $ `Hip Replacement Post-Op Q Work`                    <dbl> 4, 4, 2, 4, 2, 2, 3, ~
## $ `Hip Replacement Post-Op Q Score`                   <dbl> 43, 38, 26, 36, 35, 2~
## $ `Hip Replacement OHS Post-Op Q Predicted`           <dbl> 42.20017, 35.29577, 2~
```

**Select age and quality of life score pre and post operation**

```
age_EQ5D <- hip_data %>%
  select(`Age Band`,`Pre-Op Q EQ5D Index`,`Post-Op Q EQ5D Index`) %>%
  rename(Age  = `Age Band`,
         EQ5D_Pre = `Pre-Op Q EQ5D Index`,
         EQ5D_Post = `Post-Op Q EQ5D Index`
         )

head(age_EQ5D)
```

```
## # A tibble: 6 x 3
##   Age   EQ5D_Pre EQ5D_Post
##   <chr>    <dbl>     <dbl>
## 1 *       NA         0.516
## 2 *       -0.003    NA
## 3 *       NA        -0.074
## 4 *        0.03      0.796
## 5 *       -0.239     0.62
```

```
## 6 *        0.159     0.691
```

### Identify and remove missing values

```
age_EQ5D$Age %>% unique()
```

```
## [1] "*"        "60 to 69" "70 to 79" "80 to 89" "50 to 59" "40 to 49"
```

```
age_EQ5D$Age %>% table()
```

```
## .
##        * 40 to 49 50 to 59 60 to 69 70 to 79 80 to 89
##     2309      275     2998     8303    11157     3878
```

```
age_EQ5D %>% summary()
```

```
##      Age               EQ5D_Pre          EQ5D_Post
##  Length:28920       Min.   :-0.5940   Min.   :-0.5940
##  Class :character   1st Qu.: 0.0300   1st Qu.: 0.6910
##  Mode  :character   Median : 0.3640   Median : 0.8150
##                     Mean   : 0.3357   Mean   : 0.7975
##                     3rd Qu.: 0.6200   3rd Qu.: 1.0000
##                     Max.   : 1.0000   Max.   : 1.0000
##                     NA's   :1794      NA's   :1104
```

```
age_EQ5D_noNA <- age_EQ5D %>%
  drop_na() %>%
  filter(Age !='*')

table(age_EQ5D_noNA$Age)
```

```
##
## 40 to 49 50 to 59 60 to 69 70 to 79 80 to 89
##      261     2808     7647     9986     3340
```

```
summary(age_EQ5D_noNA)
```

```
##      Age               EQ5D_Pre         EQ5D_Post
##  Length:24042       Min.   :-0.594   Min.   :-0.5940
##  Class :character   1st Qu.: 0.055   1st Qu.: 0.6910
##  Mode  :character   Median : 0.516   Median : 0.8150
##                     Mean   : 0.339   Mean   : 0.7995
##                     3rd Qu.: 0.656   3rd Qu.: 1.0000
##                     Max.   : 1.000   Max.   : 1.0000
```

### Check that data is tidy

The data frame is not tidy, because the column names EQ5D_Pre and EQ5D_Post contain *data*: the time point when EQ5D was measured: pre or post operation.

```r
head(age_EQ5D_noNA)
```

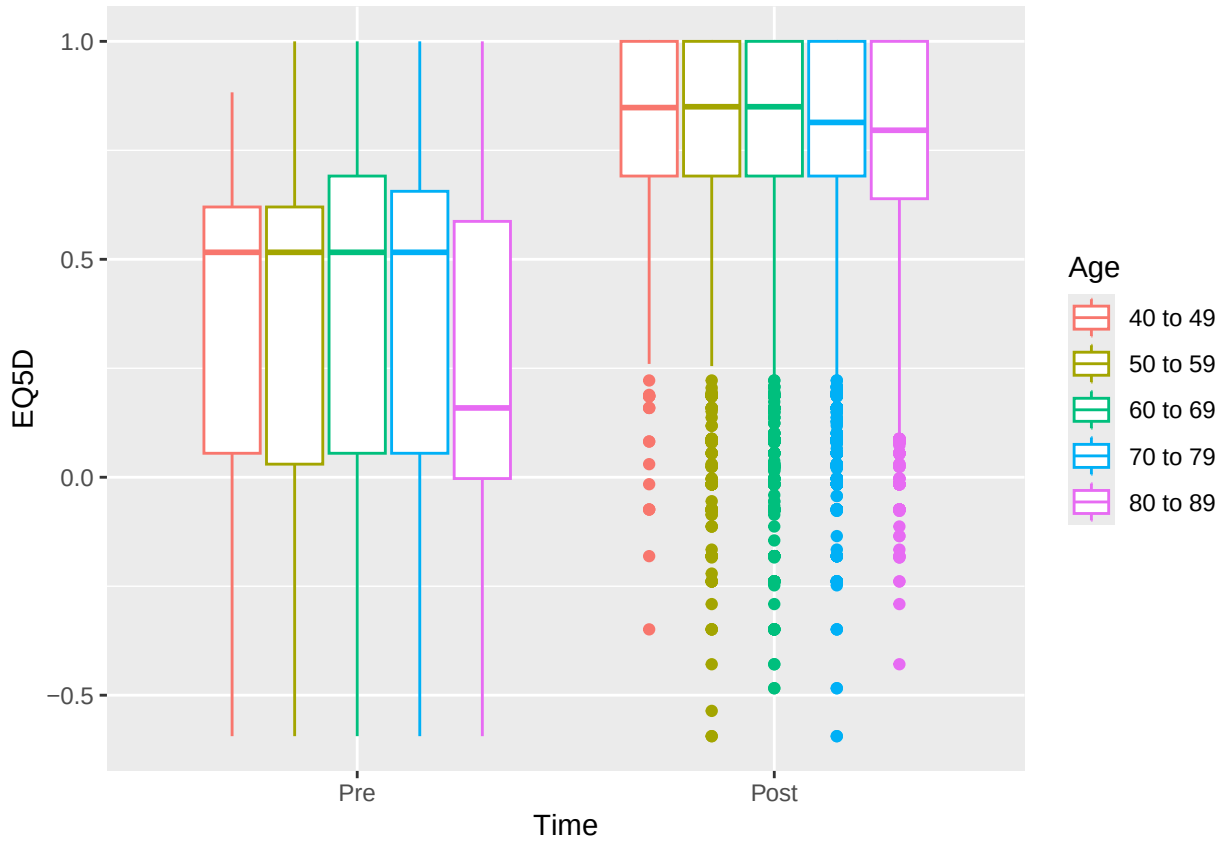
```
## # A tibble: 6 x 3
##   Age      EQ5D_Pre EQ5D_Post
##   <chr>       <dbl>     <dbl>
## 1 60 to 69   -0.016     0.516
## 2 60 to 69    0.159     0.743
## 3 60 to 69    0.03      0.727
## 4 60 to 69    0.587     0.85
## 5 60 to 69    0.623     0.796
## 6 60 to 69    0.691     1
```

```r
tidy_age_EQ5D_noNA <- age_EQ5D_noNA %>%
  pivot_longer(c(EQ5D_Pre,EQ5D_Post),
               names_to = 'Time',   # the name of the column to create from the data stored in the orig
               names_prefix = 'EQ5D_',  # remove this text from the start of each variable name
               values_to = 'EQ5D' # the name of the column to create from the data stored in cell value
               )

head(tidy_age_EQ5D_noNA)
```

```
## # A tibble: 6 x 3
##   Age      Time    EQ5D
##   <chr>    <chr>  <dbl>
## 1 60 to 69 Pre   -0.016
## 2 60 to 69 Post   0.516
## 3 60 to 69 Pre    0.159
## 4 60 to 69 Post   0.743
## 5 60 to 69 Pre    0.03
## 6 60 to 69 Post   0.727
```

### Plot quality of life pre and post operation for each age group

```r
# Turn Time into a "factor" so we can order the categories any way we want
# otherwise they are alphabetical and "Post" ends up before "Pre"
tidy_age_EQ5D_noNA$Time <- factor(tidy_age_EQ5D_noNA$Time,levels=c('Pre','Post'))

# ggplot creates a blank canvas, to which we add a boxplot with "geom_boxplot"
tidy_age_EQ5D_noNA %>%
  ggplot() +
  geom_boxplot(aes(x = Time, y = EQ5D, colour = Age))
```


1.0
0.5
0.0
−0.5
EQ5D
Pre
Post
Time
Age
40 to 49
50 to 59
60 to 69
70 to 79
80 to 89