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Documentation *TwinLife* Data:

Global Physical Activity Questionnaire (GPAQ)

F2F3 v1.0.0

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Table of content

Introduction

This technical report provides an overview of the physical activity assessment in the TwinLife study. The report begins with a description of the measurement and correction of the data, followed by an explanation of the procedure for generating variables that indicate physical activity in the TwinLife dataset. These generated variables are included in the data release starting with v8.0.0, and relevant information on how to use them are given in this report. Lastly, limitations and further aspects regarding the physical activity data are discussed. Further details can be found in the appendices.

Measurement description

The Global Physical Activity Questionnaire (GPAQ) developed by the World Health Organization (WHO) is a standardized tool to measure physical activity in face-to-face interviews (Armstrong & Bull, 2006). The final version of the GPAQ consists of 16 items (P1-P16) and collects information on physical activity participation in three domains: activity at work (P1-P6), travel to and from places (P7-P9), and recreational activities (P11-P15), as well as on sedentary behavior (P16) (WHO, n.d.). The assessment includes frequency and intensity of physical activity in different settings. To analyze the GPAQ data, the developers recommend calculating the Metabolic Equivalents (METs), a commonly used unit for expressing the physical activity intensity (WHO, n.d., p. 3). Although one MET is defined as the ratio of a person's working metabolic rate relative to the resting metabolic rate equivalent to a caloric consumption of 1 kcal/kg/hour (WHO, n.d., p. 3), the use of METs and its existing guidelines are debated (see Byrne et al., 2005; Lavie & Milani, 2007; deJong, 2010).

The first studies on GPAQ's reliability and validity reveal moderate to substantial reliability coefficients (Kappa .67 to .73; Spearman's rho .67 to .81) and a moderate relationship between the International Physical Activity Questionnaire (IPAQ) and GPAQ for concurrent validity (Spearman's rho .45 to .57) (Bull et al., 2009). A systematic review of 26 publications (Keating et al., 2019) found good reliability for the overall physical activity (Spearman's rho 0.58 to 0.89). The reviewed studies used accelerometers, pedometers, and physical activity log to examine the concurrent validity for work-related physical activity (Spearman's rho −0.03 to 0.50), transport-related physical activity (Spearman's rho 0.04 to 0.49), and leisure-related physical activity (Spearman's rho 0.02 to 0.41) (Keating et al., 2019). Though the validity's range is weak, Keating et al. (2019) pointed out that the inconsistent results regarding reliability and validity are also due to different populations and better research designs are needed for reaching conclusions regarding the concurrent validity of GPAQ. Another aspect to consider is the major discrepancy in physical activity patterns of individuals in the different physical activity domains (Wallmann-Sperlich & Froboese, 2014). Furthermore, physical activity measured with the GPAQ, is associated with age (Wallmann-Sperlich & Froboese, 2014; Mogre et al., 2015), body mass index (BMI) (Liu et al, 2018) and depression (Rutherford et al., 2022).

Adapted items in TwinLife study

For the purposes of the TwinLife study, the GPAQ items were adapted to provide a rough measure of time spent with physical activity. The scales were modified as follows: In each of the three domains (work, commuting and leisure) the questions were shortened to two items capturing frequency and excluding intensity of physical activity. The response format was adapted to assess the number of days per week, hours and minutes spent on average in physical activity. The original additional item on sedentary behavior is not included. An overview of the adapted items is attached in Appendix A. Physical activity was assessed in data collection wave 3 of the face-to-face interviews (F2F3, 2018-2020) as part of the household interview (PAPI) and in wave 5 (F2F5, 2022-2024) in a hybrid format (PAPI or online questionnaire) due to the COVID-19 pandemic. Participants of age 17 and older have been asked about their physical activity in all three domains. If participants did not have an occupation at that time, they were instructed to state their non-working status and answer the remaining questions. Younger participants (age 11 to 16) have been asked about their activity only in the domains of transport and leisure. The F2F3 data includes GPAQ data from 6,796 out of 10,503 cases.

Corrections of extreme / implausible values and handling missing data

According to the WHO's GPAQ analysis guide regarding missing data (p. 9) the GPAQ data from F2F3 were filtered as follows:

- if the hours variables have a value of 15, 30, 45 or 60, then change to minutes variable if that one is 0 (counts as data recording error)
- remove the case if the sum of hours and minutes variable exceeds over 16 hours (960 minutes) for one domain, if it has implausible values (e. g. over 7 days per week), if the answers are inconsistent (e. g. 0 days but specified hours)

Table 1 Eight cases excluded due to extreme values on a GPAQ variable

Person Identifier (*pid*)	**extreme value in the …**
146669300	… work domain with 1,200 minutes per day
219414300	… work domain with 1,200 minutes per day
262361002	… leisure domain with 1,020 minutes per day
317281001	… commuting domain with 1,200 minutes per day
442910400	… work domain with 1,200 minutes per day
463853300	… work domain with 1,080 minutes per day
471553300	… work domain with 1,200 minutes per day
481810001	… work domain with 1,080 minutes per day

1568 participants did not provide enough data for the generated scores (e.g., the hours and variable were missing; the number of days was missing; days and hours/minutes combination made no sense) and were set as missing ("-82: information incomplete") in the final scores. 8 cases with a value exceeding 16 hours (960 minutes) per day in one domain (see Table 1) have been removed from the 6,796 cases and set as missing ("-83: implausible value"). The responses from 3 participants with implausible values were handled case-by-case (see Table 2). In total there is complete and valid data from 5,220 participants in F2F3. There are 13 participants with valid data on the GPAQ variables but with no information on the age variable (see Appendix B), however other information clearly indicated that they were adults, so they were treated accordingly.

Table 2 Three Cases with corrected values on GPAQ variables

Person Identifier (*pid*)	implausible values on	reason	correction

230895400	pac0301_f2f3 = 15
	pac0302_f2f3 = -99
		data recording error	pac0301_f2f3 = -99
			pac0302_f2f3 = 15

262672300	pac0301_f2f3 = 15
	pac0302_f2f3 = 0
		data recording error	pac0301_f2f3 = 0
			pac0302_f2f3 = 15

488432110	pac0201_f2f3 = 15
	pac0202_f2f3 = -99
		data recording error	pac0201_f2f3 = -99
			pac0202_f2f3 = 15

TwinLife Dataset: generating variables

There are two ways to generate an indicator for physical activity or inactivity, as recommended in the GPAQ analysis guide (WHO, n.d., p. 14):

(1) estimate a population's mean or median physical activity with the continuous indicator MET-minutes per week or time spent in physical activity
(2) setting up a cut-point for a specific amount of physical activity to classify a certain percentage of a population as 'inactive' or insufficiently active

Considering that no information on the intensity of the activities is available, a variable with the total amount of minutes spent in physical activities per week has been calculated.

(1) time spent in physical activity in min per week (pac0400, pac0410)

For generating the variable indicating the total amount of weekly physical activity, the following formula has been applied:

For participants aged 17 and older:

*pac0400 = (pac0101 * 60 + pac0102) * pac0100 + (pac0201 * 60 + pac0202) * pac0200 + (pac0301 * 60 + pac0302) * pac0300.*

For participants 11 - 16 years old:

*pac0410 = (pac0201 * 60 + pac0202) * pac0200 + (pac0301 * 60 + pac0302) * pac0300.*

The total time spent in physical activity per week in minutes is the sum of time spent in the three domains for individuals aged 17 or older (*pac0400)* and for participants in the age group of 11 to 16 years it is the sum of two domains (commuting, leisure*; pac0410*). Both variables are calculated by converting the hour's variables (*pac0101, pac0201, pac0301*) to minutes, adding up the minute's variables (*pac0102, pac0202, pac0302*) and multiplying with the day's variables (*pac0100, pac0200, pac0300*). In the F2F3 data the first group's (n = 4,287, age ≥ 17) mean time spent in physical activity are 845.74 minutes per week (SD = 972.76, median = 480, range from 0 to 7,980 minutes). The second group's (n = 933, age 11 - 16) mean time spent in physical activity are 569.37 minutes per week (SD = 434.99, median = 460, range from 15 to 3,900 minutes).

Figure 1

Frequency of physical activity time per week for age group 17 and older

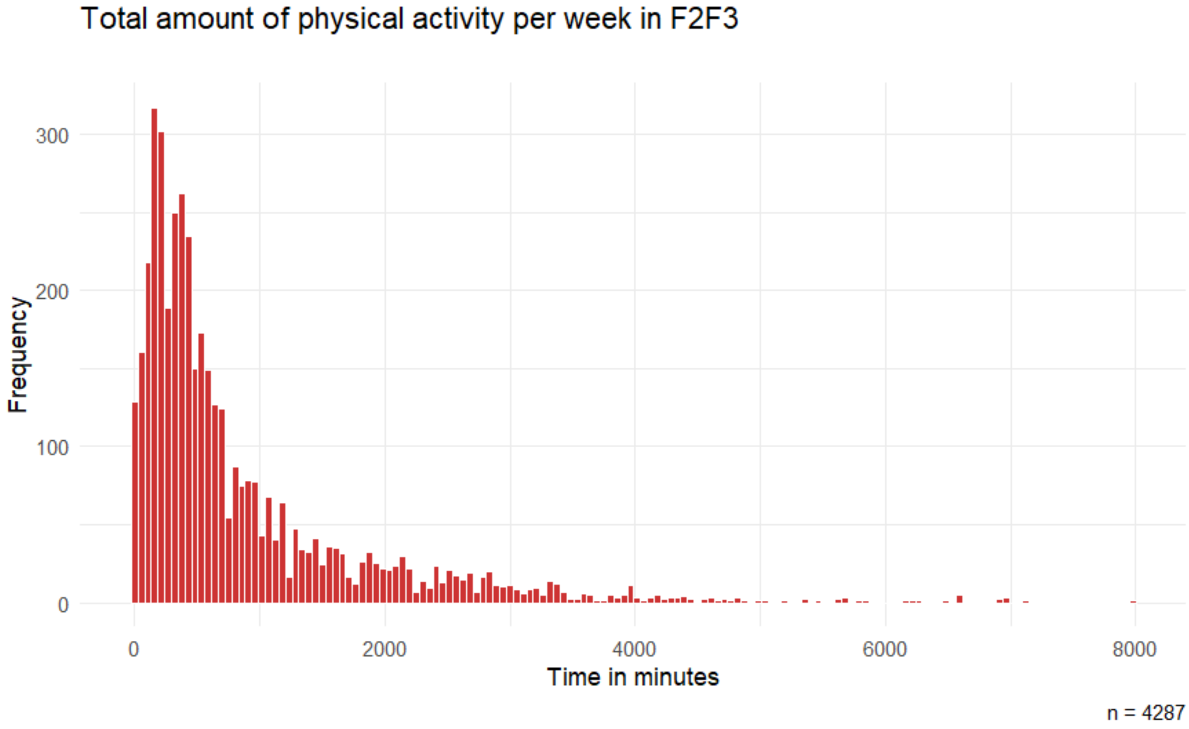
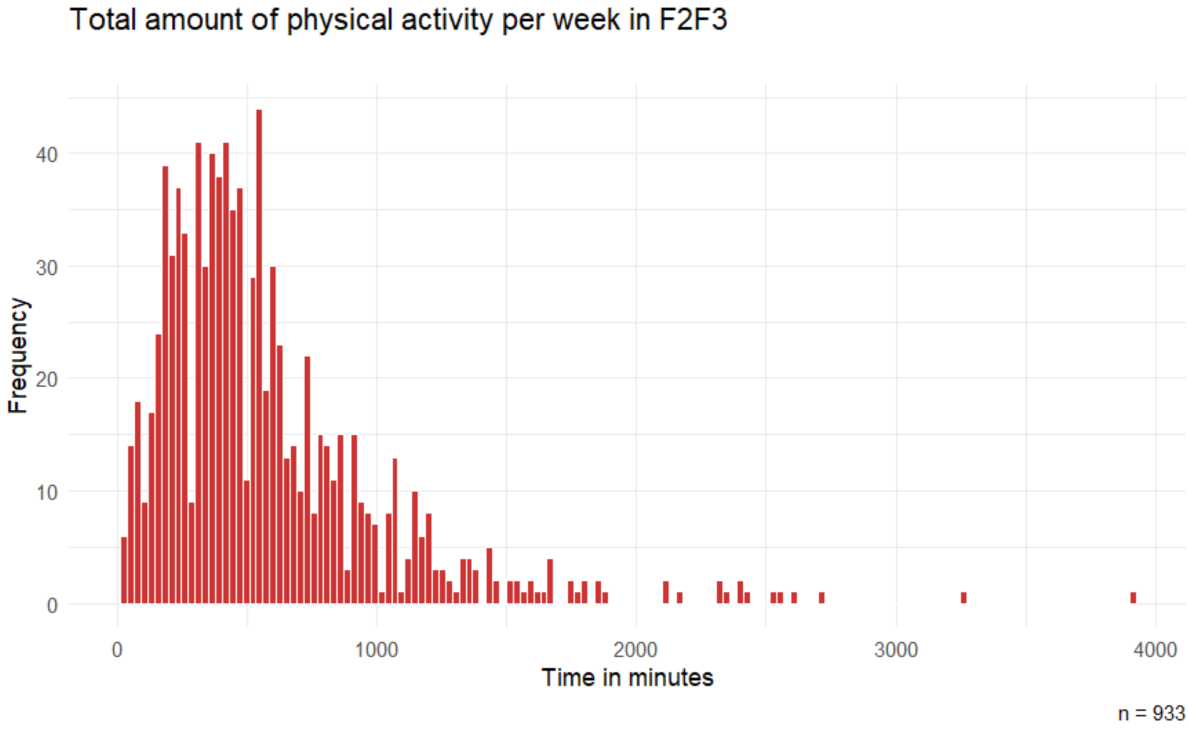


Figure 2

Frequency of physical activity time per week for age group 11 to 16



(2) level of physical activity (pac0401, pac0411)

A categorial indicator can be generated through categorizing the total time spent in physical activity per week according to the WHO recommendations: throughout a week adults should do at least 150 minutes of moderate-intensity physical activity, 75 minutes of vigorous-intensity physical activity (WHO, n.d., p. 14). For children and adolescents aged 5 to 17 years it is recommended to do physical activity at least an average of 60 minutes per day of moderate-to-vigorous intensity, that means at least 420 minutes throughout the week. In this dataset the cut-point for classifying physical activity is set at 150 minutes per week for individuals aged 17 or older (*pac0401*) as there is no information on the intensity of physical activity available and this cut-off would not overestimate the inactive group. The cut-point for classifying physical activity for individuals under 17 years (*pac0411*) is set at 420 minutes per week. In the F2F3 data the age group 17 or older (n = 4,287) has 3671 participants with a high level of physical activity (150 minutes or more per week) and 616 with a low level of physical activity (less than 150 minutes per week). In the latter group 117 participants even stated that they do not spent any time on physical activity in any of the three areas (0 minutes per week). While in the group of the younger participants aged from 11 to 16 (n = 933) there were 508 individuals with a high level of physical activity (420 minutes or more per week) and 425 with a low level of physical activity (less than 420 minutes per week). Comparing to the data on daily physical activity time for the age group 11 to 16, 662 individuals reported more than the recommended 60 minutes daily while 271 participants stated 60 minutes or less.

Limitations

Some of the GPAQ's limitations are addressed as follows: Only self-reported data are assessed with the GPAQ; therefore, the accuracy of the data cannot be verified without objective data, which are not available in the TwinLife dataset. General restrictions of self-reports (e.g. biased response due to social desirability) need to be considered when interpreting the data. The GPAQ measures the physical activity of a typical week, although other factors like adaptions to seasonal changes can impact the structure of a typical week leading to different data (Keating et al., 2019, p. 24). Keating et al. (2019, p. 24) also mentioned that the measurement of physical activity in the three domains can only be accurate if the participants clearly distinguish their activity related to work, transport and leisure. They further noted the gap between the reports on work-related physical activity from working and non-working individuals, which limits tracking of physical activity among children and adolescents (Keating et al., 2019, p.24). In the F2F3 data 647 out of 6,796 participants stated their non-working status.

The physical activity data assessed in TwinLife can be used as rough estimates of frequency of physical activity. However, the data should not be used to calculate METs because the intensity of physical activity has not been measured. Please note that the items have been adapted to fit economic needs of the TwinLife study, so comparability to the original scale has yet to be determined.

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Appendix A

Adapted GPAQ items in *TwinLife*
For further information (e.g. coding, filtering), please refer to the codebook of F2F3 (v.7-1-0, ZA6701_person_wid5).

Variable name	Variable label	Question text
pac0100	physical activity at work – number of days per week	On how many days in a usual week do you engage in physical activity at work (e.g., lifting or carrying loads, delivering on foot or bicycle, working on your knees, construction work, or digging)?
pac0101	physical activity at work - time/working day: hours	How much time do you usually spend on these activities during such a working day? [item text: hours]
pac0102	physical activity at work - time/working day: minutes	How much time do you usually spend on these activities during such a working day? [item text: minutes]
pac0200	longer distances on foot or by bike - number of days per week	On how many days in a usual week do you cover longer distances on foot or by bicycle (for example, to go grocery shopping or on the way from home to school or for a walk)?
pac0201	longer distances on foot or by bike - time / day: hours	How much time do you usually need to cover these distances on such a day? [item text: hours]
pac0202	longer distances on foot or by bike - time / day: minutes	How much time do you usually need to cover these distances on such a day? [item text: minutes]
pac0300	physical activity in leisure time - number of days per week	On how many days of a usual week do you engage in physical activity in your free time (e.g., through sports such as soccer, tennis, weight training, jogging, swimming, bicycling, or through other activities such as gardening)?
pac0301	physical activity in leisure time - time / day: hours	How much time do you usually spend on these activities on such a day? [item text: hours]
pac0302	physical activity in leisure time - time / day: minutes	How much time do you usually spend on these activities on such a day? [item text: minutes]

Appendix B

This Table contains the 13 cases with valid data on GPAQ-variables but missing age value in the F2F3 dataset. According to the type of respondent (*ptyp*) and twin birth cohort (*cgr*) all 13 cases have been categorized on their level of physical activity in reference to WHO's recommendation for the age group of 17 years and older (*pac0400*).

Person Identifier (*pid*)	**twin birth cohort (*cgr*)**	**Type of respondent (*ptyp*)**	**Description of *cgr* and *ptyp***
111728600	1	600	twins born 2009/2010 partner of father
263326500	2	500	twins born 2003/2004 partner of mother
330504111	3	110	twins born 1997/1998 partner of first interviewed twin
376014110	3	110	twins born 1997/1998 partner of first interviewed twin
387848600	3	600	twins born 1997/1998 partner of father
423092500	4	500	twins born 1990 – 1993 partner of mother
439036120	4	120	twins born 1990 – 1993 partner of second interviewed twin
448198120	4	120	twins born 1990 – 1993 partner of second interviewed twin
452729120	4	120	twins born 1990 – 1993 partner of second interviewed twin
456901110	4	110	twins born 1990 – 1993 partner of first interviewed twin
474152120	4	120	twins born 1990 – 1993 partner of second interviewed twin
488432110	4	110	twins born 1990 – 1993 partner of first interviewed twin
493584121	4	120	twins born 1990 – 1993 partner of second interviewed twin

Appendix C

R (Version 4.2.2) and RStudio (Version 2023.12.0 Build 369) has been used to generate the variables *pac0400*, *pac0401, pac0410 and pac0411*.

```r
library(haven)
library(dplyr)

library(tidyverse)

library(ggplot2)
library(psych)


search_var_function <- function(dataset, stamm, variables ="[0-9]{4}", suffix="", zeitpunkt="(f2f|cati|cov)[1-5](_inv|_rec)?"){

if (nchar(as.character(substitute(variables))) == 1){
number_char <- paste0(as.character(substitute(variables)),"[0-9]{3}") # define search pattern here
} else if (nchar(as.character(substitute(variables))) == 2){
number_char <- paste0(as.character(substitute(variables)),"[0-9]{2}")
} else if (nchar(as.character(substitute(variables))) == 3){
number_char <- paste0(as.character(substitute(variables)),"[0-9]{1}")
} else if (nchar(as.character(substitute(variables))) == 4){
number_char <- paste0(as.character(substitute(variables)))
} else {number_char <- paste0(as.character(substitute(variables)))}
suchmuster <- paste0("^",as.character(substitute(stamm)),number_char, as.character(substitute(suffix)),"\\_", as.character(substitute(zeitpunkt)))
print("This is the searching pattern: ")
print(suchmuster)
ergebnis_vector <- c()
  for (i in colnames(dataset)){
    if (grepl(suchmuster ,i)){
    ergebnis_vector <- c(ergebnis_vector,i)
    }
  }
if (length(ergebnis_vector) == 0) {
  print("Variables not found")
}
inverted<- ergebnis_vector[grep("_rec|_inv", ergebnis_vector)]
inverted_first <- substr(inverted, 1, nchar(inverted)-4)
ergebnis_v <- setdiff(ergebnis_vector, inverted_first)
return(ergebnis_v)
}

# import relevant dataset (file should be in the same working directory)
f2f3_data <- read_dta("Y:/Release_7-1-0/TL_v7-1-0_Stata/ZA6701_person_wid5_v7-1-0.dta")

# add a suffix to f2f3 data
f2f3_data <- f2f3_data %>% rename_at(vars(everything()), ~ paste0(., "_f2f3"))
```

```
# rename the pid variable used for merging datasets
f2f3_data <- f2f3_data %>% rename(pid = pid_f2f3)

# copy of dataset
data <- f2f3_data

# creating a vector to indicate which variables to keep
pac_vector <- search_var_function(data, pac, "0[1-3]0[0-2]")

## [1] "This is the searching pattern: "
## [1] "^pac0[1-3]0[0-2]\\_(f2f|cati|cov)[1-5](_inv|_rec)?"

var_keep_f2f3 <- c("pid","cgr_f2f3","ptyp_f2f3", "sex_f2f3", "zyg0102_f2f3"
, "age0100_f2f3")
var_keep <- c(var_keep_f2f3, pac_vector)

# subset data to relevant variables
sub_data <- subset(data, select = var_keep)
sub_data [] <- lapply(sub_data , as.numeric)

# check variables and distributions
describe(sub_data)

# view labels of a GPAQ variable (also described in the codebook of F2F3)
# print_labels(sub_data$pac0100_f2f3)

# create variable indicating if case is valid (1) or not (0)
# invalid cases: cases with too many missings that means coding lesser than
-81 in more than one domain on days variable
sub_data <- sub_data %>% mutate(valid_95 = case_when(pac0100_f2f3 >= -81 |
pac0200_f2f3 > -85 | pac0300_f2f3 > -85 |
                                                     pac0101_f2f3 >= -81 |
pac0201_f2f3 > -85 | pac0301_f2f3 > -85 |
                                                     pac0102_f2f3 >= -81 |
pac0202_f2f3 > -85 | pac0302_f2f3 > -85 ~ 1))

table(is.na(sub_data$valid_95))

##
## FALSE  TRUE
##  6796  3707

# replace NA with zero
sub_data$valid_95[is.na(sub_data$valid_95)] <- 0
# 6796 cases with data
table(sub_data$valid_95)

##
##    0    1
## 3707 6796

# next filtering: invalid cases: missing data on both hours and minutes var
iables
# view dataset to check filtering
# View(sub_data[, c("pid","age0100_f2f3", "pac0100_f2f3", "pac0101_f2f3","p
ac0102_f2f3","pac0200_f2f3","pac0201_f2f3","pac0202_f2f3","pac0300_f2f3","p
ac0301_f2f3","pac0302_f2f3","invalid")])
```

```
# three variables for three domains indicating if there is data on the crit
ical variables
# work
sub_data$valid_work <- ifelse(
  ((sub_data$pac0100_f2f3 == -81 | sub_data$pac0100_f2f3 == 0) & (sub_data$
pac0101_f2f3 <= 0 & sub_data$pac0102_f2f3 <= 0)) |
    (sub_data$pac0100_f2f3 > 0 & (sub_data$pac0101_f2f3 > 0 | sub_data$pac0
102_f2f3 > 0)), 1, 0  )
table(sub_data$valid_work)
```

```
##
##    0    1
## 5522 4981
```

```
# travel
sub_data$valid_commuting <- ifelse(
  ((sub_data$pac0200_f2f3 == 0) & (sub_data$pac0201_f2f3 <= 0 & sub_data$pa
c0202_f2f3 <= 0)) |
    (sub_data$pac0200_f2f3 > 0 & (sub_data$pac0201_f2f3 > 0 | sub_data$pac0
202_f2f3 > 0)), 1, 0  )
table(sub_data$valid_commuting)
```

```
##
##    0    1
## 4525 5978
```

```
# leisure
sub_data$valid_leisure <- ifelse(
  ((sub_data$pac0300_f2f3 == 0) & (sub_data$pac0301_f2f3 <= 0 & sub_data$pa
c0302_f2f3 <= 0)) |
    (sub_data$pac0300_f2f3 > 0 & (sub_data$pac0301_f2f3 > 0 | sub_data$pac0
302_f2f3 > 0)), 1, 0  )
table(sub_data$valid_leisure)
```

```
##
##    0    1
## 4334 6169
```

```
# variable indicating if all critical data exist for each case: missing cod
e -82 for incomplete cases
# 1 = valid, 0 = invalid
# invalid missings: missing on days variable or missings on hours / minutes
variables (critical info)
# 5274  invalid missings, 5229  valid missings
sub_data$valid_82 <- ifelse((sub_data$age0100_f2f3 >= 17 | sub_data$age0100
_f2f3 == -99) & (sub_data$valid_work == 1 & sub_data$valid_commuting == 1 &
sub_data$valid_leisure ==1), 1, 0)
sub_data$valid_82 <- ifelse((sub_data$age0100_f2f3 <= 16 & sub_data$age0100
_f2f3 > 10) & (sub_data$valid_commuting == 1 & sub_data$valid_leisure ==1),
1, sub_data$valid_82)

table(sub_data$valid_82[sub_data$valid_95 == 1])
```

```
##    0    1
## 1568 5228
```

```r
# 13 participants with missing age value
table(sub_data$age0100_f2f3[sub_data$valid_82 == 1])

# Subset with cases missing value on age variable
missing_age <- sub_data %>%  filter(age0100_f2f3 == -99 & valid_82 == 1)
# check hours variable with values 15, 30, 45, 60 while 0 on minutes variab
le
mismatched_values <- sub_data %>% filter(valid_82 == 1 & (pac0101_f2f3 == 1
5 | pac0101_f2f3 == 30 | pac0101_f2f3 == 45 | pac0101_f2f3 == 60 | pac0201_
f2f3 == 15 | pac0201_f2f3 == 30 | pac0201_f2f3 == 45 | pac0201_f2f3 == 60 |
pac0301_f2f3 == 15 | pac0301_f2f3 == 30 | pac0301_f2f3 == 45 | pac0301_f2f3
== 60)  )
# 3 cases with mismatched values on hours variable: correcting case-by-case
# pid: 230895400 262672300 488432110
print(mismatched_values$pid)
```

```
## [1] 230895400 262672300 488432110
```

```r
# mismatched_values[, c("pid", "pac0101_f2f3", "pac0102_f2f3", "pac0201_f2f
3", "pac0202_f2f3", "pac0301_f2f3", "pac0302_f2f3")]

# copy dataset to have the raw data as a reference
sub_data_copy <- sub_data
sub_data_copy <- sub_data_copy %>% rename_at(vars(everything()), ~ paste0(.
, "_copy"))

# correcting case-by-case for mismatched values
# case 1: pid 230895400
sub_data$pac0301_f2f3[sub_data$pid == 230895400]
```

```
## [1] 15
```

```r
sub_data$pac0302_f2f3[sub_data$pid == 230895400]
```

```
## [1] -99
```

```r
sub_data$pac0301_f2f3[sub_data$pid == 230895400] <- -99
sub_data$pac0302_f2f3[sub_data$pid == 230895400] <- 15
sub_data$pac0301_f2f3[sub_data$pid == 230895400]
```

```
## [1] -99
```

```r
sub_data$pac0302_f2f3[sub_data$pid == 230895400]
```

```
## [1] 15
```

```r
# case 2: pid 262672300
sub_data$pac0301_f2f3[sub_data$pid == 262672300]
```

```
## [1] 15
```

```r
sub_data$pac0302_f2f3[sub_data$pid == 262672300]
```

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

```r
sub_data$pac0301_f2f3[sub_data$pid == 262672300] <- 0
sub_data$pac0302_f2f3[sub_data$pid == 262672300] <- 15
sub_data$pac0301_f2f3[sub_data$pid == 262672300]
```

```
## [1] 0

sub_data$pac0302_f2f3[sub_data$pid == 262672300]

## [1] 15

# case 3: pid 488432110
sub_data$pac0201_f2f3[sub_data$pid == 488432110]

## [1] 15

sub_data$pac0202_f2f3[sub_data$pid == 488432110]

## [1] -99

sub_data$pac0201_f2f3[sub_data$pid == 488432110] <- -99
sub_data$pac0202_f2f3[sub_data$pid == 488432110] <- 15
sub_data$pac0201_f2f3[sub_data$pid == 488432110]

## [1] -99

sub_data$pac0202_f2f3[sub_data$pid == 488432110]

## [1] 15

# recoding to 0
sub_data[sub_data <= -81] <- 0

# rename the pid variable used for merging datasets
sub_data_copy  <- sub_data_copy  %>% rename(pid = pid_copy)
sub_data <- left_join(sub_data, sub_data_copy, by = "pid")

# calculate total amount of time spent on physical activity weekly
sub_data <- sub_data %>% mutate(pac0400 = (pac0101_f2f3 * 60 + pac0102_f2f3
) * pac0100_f2f3  + (pac0201_f2f3  * 60 + pac0202_f2f3 ) * pac0200_f2f3  +
(pac0301_f2f3  * 60 + pac0302_f2f3 ) * pac0300_f2f3,
                                        patime_work_daily = (pac0101_f2f3 *
60 + pac0102_f2f3 ) ,
                                        patime_commute_daily = (pac0201_f2f
3  * 60 + pac0202_f2f3 ) ,
                                        patime_leisure_daily = (pac0301_f2f
3  * 60 + pac0302_f2f3 ) )

# if one domain exceeds 16 hours (960 minutes) exclude the case
table(sub_data$patime_work_daily)

table(sub_data$patime_commute_daily )

table(sub_data$patime_leisure_daily)



extreme_values<- filter(sub_data, ((sub_data$valid_95 == 1 & sub_data$valid
_82 == 1) & (patime_work_daily > 960 | patime_commute_daily > 960 | patime_
leisure_daily > 960)))
# View(extreme_values[, c("patime_work_daily", "patime_commute_daily","pati
me_leisure_daily","age0100_f2f3", "pid")])

# 1 = valid case, 0 = invalid case because of extreme value in at least one
```

```
domain
sub_data$valid_83 <- ifelse(sub_data$patime_work_daily > 960 | sub_data$pat
ime_commute_daily > 960 | sub_data$patime_leisure_daily > 960, 0, 1)
table(sub_data$valid_83[(sub_data$valid_95 == 1 & sub_data$valid_82 == 1)])

##
##    0    1
##    8 5220

# missing codes
table(sub_data$pac0400)

sub_data$pac0400 <- ifelse(sub_data$valid_83 == 0, -83, sub_data$pac0400)
sub_data$pac0400 <- ifelse(sub_data$valid_82 == 0, -82, sub_data$pac0400)
sub_data$pac0400 <- ifelse(sub_data$valid_95 == 0, -95, sub_data$pac0400)

table(sub_data$pac0400)

# calculate total amount of time spent on physical activity weekly
# age <= 16 --> pac0410
# copy from pac0400 allowed because working domain was set to 0 for age gro
up 11-16
sub_data$pac0410 <- sub_data$pac0400
table(sub_data$pac0400)

# generating variable for level of physical activity
# pac0401 for group 1: aged 17 or older
# 1 = high, 0 = low
sub_data$pac0401 <- ifelse (sub_data$pac0400 >= 150, 1, 0)

sub_data$pac0401[sub_data$pac0400 ==-95] <- -95
sub_data$pac0401[sub_data$pac0400 ==-82] <- -82
sub_data$pac0401[sub_data$pac0400 ==-83] <- -83

# View(sub_data[, c("pac0100_f2f3_copy", "pac0101_f2f3_copy","pac0102_f2f3_
copy","pac0200_f2f3_copy","pac0201_f2f3_copy","pac0202_f2f3_copy","pac0300_
f2f3_copy","pac0301_f2f3_copy","pac0302_f2f3_copy","pac0400", "pac0401")])

# pac0411 for group 2: aged between 11 to 16
# 1 = high, 0 = low
sub_data$pac0411 <- ifelse (sub_data$pac0410 >= 420, 1, 0)
sub_data$pac0411[sub_data$pac0410 ==-95] <- -95
sub_data$pac0411[sub_data$pac0410 ==-82] <- -82
sub_data$pac0411[sub_data$pac0410 ==-83] <- -83

table(sub_data$pac0401)

##
##  -95  -83  -82    0    1
## 4922    7 1287  544 3743

table(sub_data$pac0411)

##
##  -95  -83  -82    0    1
## 9288    1  281  394  539
```

```
# group 1: aged 17 or older
group_1 <- sub_data %>% filter((age0100_f2f3 >= 17 | sub_data$age0100_f2f3_
copy == -99) & valid_95 == 1 & valid_82 == 1 & valid_83 == 1 )

describe(group_1$pac0400)

describe(group_1$pac0401)

ggplot(group_1, aes(x=pac0400)) +
  geom_histogram( bins = 150, colour = "white", fill = "brown3") +
  theme_minimal() +
   labs(
    title = "Total amount of physical activity per week in F2F3",
    subtitle = " ",
    caption = "n = 4287",
    x = "Time in minutes",
    y = "Frequency" )

# group 2: 16 years old or under
# over60 = total time spent on physical activity on daily basis
group_2 <- sub_data %>% filter(age0100_f2f3 <= 16 & age0100_f2f3 > 10 & val
id_95 == 1 & valid_82 == 1 & valid_83 == 1 ) %>%  mutate(over60 = ifelse ((
patime_commute_daily > 60 | patime_leisure_daily > 60), 1, 0 ))

ggplot(group_2, aes(x=pac0410)) +
  geom_histogram( bins = 150, colour = "white", fill = "brown3") +
  theme_minimal() +
   labs(
    title = "Total amount of physical activity per week in F2F3",
    subtitle = " ",
    caption = "n = 933",
    x = "Time in minutes",
    y = "Frequency" )
```

```
table(group_2$over60)

describe(group_2$pac0410)

describe(group_2$pac0411)

# check coding of "not working" on work domain days variable only: 647 vali
d cases with -81
table(sub_data$pac0100_f2f3_copy[sub_data$pac0100_f2f3_copy == -81 & sub_da
ta$valid_95 == 1 & sub_data$valid_82 == 1 & sub_data$valid_83 == 1])

##
## -81
## 647

sub_data$wid <- 5
final_data <- select(sub_data, c(pid, wid, pac0400, pac0401, pac0410, pac04
11))
# save final dataset as .rda-File
write_dta(final_data, "final_data.dta")
```