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###### Load packages ##############################

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library(foreign)

library(tidyverse)

library(dplyr)

library("psych")

library(Hmisc)

library(mice)

library('tidyr')

library(lavaan)

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###### Computing physical activity ###############################

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###### Physical activity at 9 years old: self-reported ###########

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# 1. SPORTs (HOURS/WEEK)

# C1100184\_cleaned : C11a Do you play sports at a sports club or sports team?

# 0 = No / 1 = Yes

table(df$C1100184\_cleaned)

table(is.na(df$C1100184\_cleaned))

df$sports\_participation\_9 <- ifelse(df$C1100184\_cleaned==0, 0,

ifelse(df$C1100184\_cleaned==1, 1, NA))

table(df$sports\_participation\_9)

table(is.na(df$sports\_participation\_9))

# C1100284\_cleaned: C11b How often do you play sports?

# 1 = 1 per week / 2 = 2 per week / 3 = 3 per week / 4 = 4 per week / 5 = 5 times or more per week

table(df$C1100284\_cleaned)

table(is.na(df$C1100284\_cleaned))

df$sports\_days\_9 <- ifelse(df$C1100284\_cleaned==1, 1,

ifelse(df$C1100284\_cleaned==2, 2,

ifelse(df$C1100284\_cleaned==3, 3,

ifelse(df$C1100284\_cleaned==4, 4,

ifelse(df$C1100284\_cleaned==5, 6, NA)))))

table(df$sports\_days\_9)

table(is.na(df$sports\_days\_9))

# total sport time (hours/week). I assume that each day they play sport for 1 hour, so no need to add (\* 1)

df$PAchildSPORT <- df$sports\_participation\_9 \* df$sports\_days\_9

describe(df$PAchildSPORT )

# 2. PLAY OUTSIDE (HOURS/WEEK)

# C1000184\_cleaned: C10a How many days a week do you play outside (think soccer or skating)?

# 1 = Never / 2 = Not every week / 3 = 1 d/w / 4 = 2 d/w / 5 = 3 d/w / 6 = 4 d/w / 7 = 5 d/w / 8 = >5d/w

table(df$C1000184\_cleaned)

table(is.na(df$C1000184\_cleaned))

df$play\_days\_9 <- ifelse(df$C1000184\_cleaned==1, 0,

ifelse(df$C1000184\_cleaned==2, 0.5,

ifelse(df$C1000184\_cleaned==3, 1,

ifelse(df$C1000184\_cleaned==4, 2,

ifelse(df$C1000184\_cleaned==5, 3,

ifelse(df$C1000184\_cleaned==6, 4,

ifelse(df$C1000184\_cleaned==7, 5,

ifelse(df$C1000184\_cleaned==8, 6, NA))))))))

table(df$play\_days\_9)

table(is.na(df$play\_days\_9))

# C1000284\_cleaned: C10b When you play out, how long do you play around outside?

# 1 = Less than 30 min/d / 2 = 30 to 60 min/d / 3 = 1 to 2 h/d / 4 = 2 to 3 h/d / 5 = 3 to 4 h/d / 6 = >4 h/d

# Recode: The score of the maximum value (i.e., more than 240 min) is increased in a 12.5% (as done for all the variables)

table(df$C1000284\_cleaned)

table(is.na(df$C1000284\_cleaned))

df$play\_min\_9 <- ifelse(df$C1000284\_cleaned==1, 15,

ifelse(df$C1000284\_cleaned==2, 45,

ifelse(df$C1000284\_cleaned==3, 90,

ifelse(df$C1000284\_cleaned==4, 150,

ifelse(df$C1000284\_cleaned==5, 210,

ifelse(df$C1000284\_cleaned==6, 270, NA))))))

table(df$play\_min\_9)

table(is.na(df$play\_min\_9))

# total play time (hours/week)

df$PAchildPLAY = df$play\_days\_9 \* (df$play\_min\_9 / 60)

describe(df$PAchildPLAY )

# 4. TOTAL PHYSICAL ACTIVITY (hours/week)

df$PAchildTOTAL = df$PAchildSPORT + df$PAchildPLAY

describe(df$PAchildTOTAL)

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###### Computing physical activity ###############################

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###### Physical activity at 9 years old: mothers' report #########

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# 1. SPORTs (HOURS/WEEK)

# H0700281\_cleaned : (GR1081 H7-b) How many hours per week does your child spend doing sports (training and compete together)?

# 1 = Less than 1 hour per week / 2 = 1 to 2 hours per week / 3 = 2 to 4 hours per week / 4 = More than 4 hours per week

# Recode: The score of the maximum value (i.e., more than 240 min) is increased in a 12.5% (as done for all the variables)

table(df$H0700281\_cleaned)

table(is.na(df$H0700281\_cleaned))

df$PAparentSPORT <- ifelse(df$H0700281\_cleaned==1, 0.5,

ifelse(df$H0700281\_cleaned==2, 1.5,

ifelse(df$H0700281\_cleaned==3, 3,

ifelse(df$H0700281\_cleaned==4, 4.5, NA))))

table(df$PAparentSPORT)

table(is.na(df$PAparentSPORT))

describe(df$PAparentSPORT)

# 2. PLAY OUTSIDE (MIN/WEEK)

# H0800181\_cleaned (GR1081 H8-a) On average how many days per week does your child play outside?

# 1 = Never / 2 = 1 or 2 days per week / 3 = 3 or 4 days per week / 4 = 5 or more days per week

table(df$H0800181\_cleaned)

table(is.na(df$H0800181\_cleaned))

df$play\_maternal\_report\_days\_9 <- ifelse(df$H0800181\_cleaned==1, 0,

ifelse(df$H0800181\_cleaned==2, 1.5,

ifelse(df$H0800181\_cleaned==3, 3.5,

ifelse(df$H0800181\_cleaned==4, 6, NA))))

table(df$play\_maternal\_report\_days\_9)

table(is.na(df$play\_maternal\_report\_days\_9))

# H0800281\_cleaned: (GR1081 H8-b) Approximately how long does your child approximately play outside per day? Only consider the days that your child plays outside.

# 1 = Less than 30 minutes per day / 2 = 30 minutes to 1 hour per day / 3 = 1 to 2 hours per day / 4 = 2 to 3 hours per day / 5 = 3 to 4 hours per day / 6 = More than 4 hours per day

# Recode: The score of the maximum value (i.e., more than 240 min) is increased in a 12.5% (as done for all the variables)

table(df$H0800281\_cleaned)

table(is.na(df$H0800281\_cleaned))

df$play\_maternal\_report\_min\_9 <- ifelse(df$H0800281\_cleaned==1, 0.25,

ifelse(df$H0800281\_cleaned==2, 0.75,

ifelse(df$H0800281\_cleaned==3, 1.5,

ifelse(df$H0800281\_cleaned==4, 2.5,

ifelse(df$H0800281\_cleaned==5, 3.5,

ifelse(df$H0800281\_cleaned==6, 4.5, NA))))))

table(df$play\_maternal\_report\_min\_9)

table(is.na(df$play\_maternal\_report\_min\_9))

# total play time (hours/week)

df$PAparentPLAY = df$play\_maternal\_report\_days\_9 \* df$play\_maternal\_report\_min\_9

describe(df$PAparentPLAY)

# 4. TOTAL PHYSICAL ACTIVITY (hours/week)

df$PAparentTOTAL = df$PAparentSPORT + df$PAparentPLAY

describe(df$PAparentTOTAL)

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###### Participants: inc/exc #######################

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# step 1. Flowchart (starting from 5009 participants undertaking, at least, one brain scan)

df <- subset(df, (df$mri\_consent\_f09 == "yes" | df$mri\_consent\_f13 == "yes"))

# step 2. Participants with good quality brain structure measurement in, at least, 1 time point (from 5009 to 4121, n=888)

# Of 4121 participants, 1956 has brain only at 9, 936 only at 13 and 1229 at both time points

table(df$exclude\_incidental\_f09=="exclude" | df$exclude\_incidental\_f13=="exclude") # 41 have incidental

df$braces <- 0

table(df$braces)

table(df$has\_braces\_mri\_f09) # 88 has braces at f09

table(df$has\_braces\_mri\_f13) # 1078 has braces at f13

table(df$has\_braces\_mri\_f09 =="braces" & df$has\_braces\_mri\_f13 =="braces") # 17 has braces at both f09 and f13

table(df$has\_braces\_mri\_f09 =="braces" | df$has\_braces\_mri\_f13 =="braces")# 1149 (correct: 88+1078-17) will be excluded because of having brace at, at least, one time point

df$outcome9 <- ifelse(((df$mri\_consent\_f09 == "yes" & df$has\_braces\_mri\_f09 =="no" & df$t1\_has\_nii\_f09=="yes" &

df$exclude\_incidental\_f09 == "include" & df$freesurfer\_qc\_f09 == "usable" &

df$t1\_asset\_has\_nii\_f09 != "exclude")), 8, 0)

df$outcome13 <- ifelse(((df$mri\_consent\_f13 == "yes") & (df$has\_braces\_mri\_f13 =="no") & (df$t1\_has\_nii\_f13=="yes") &

(df$exclude\_incidental\_f13 == "include") & (df$freesurfer\_qc\_f13 == "usable")), 12, 0)

df$outcome9[is.na(df$outcome9)] <- 0

df$outcome13[is.na(df$outcome13)] <- 0

df$outcome <- df$outcome9 + df$outcome13

table(df$outcome9) # (n=3185) has brain at 9

table(df$outcome13) # (n=2165) has brain at 13

table(df$outcome) # (n=1956) has brain only at 9, (n=936) has brain only at 13, (n=1229) has brain data at both 9 and 13

df <- subset(df, (df$outcome > 1))

# To delete brain data at 9 if they are not of quality

table(df$outcome9) # n=3185 participants

describe(df$CortexVol\_f09)

df$CortexVol\_f09[(df$outcome == 12)] <- NA

describe(df$CortexVol\_f09) # n=3185 participants, match!

describe(df$SubCortGrayVol\_f09)

df$SubCortGrayVol\_f09[(df$outcome == 12)] <- NA

describe(df$SubCortGrayVol\_f09) # n=3185 participants, match!

describe(df$eTIV\_f09)

df$eTIV\_f09[(df$outcome == 12)] <- NA

describe(df$eTIV\_f09) # n=3185 participants, match!

describe(df$CerebralWhiteMatterVol\_f09)

df$CerebralWhiteMatterVol\_f09[(df$outcome == 12)] <- NA

describe(df$CerebralWhiteMatterVol\_f09) # n=3185 participants, match!

describe(df$Left\_Amygdala\_vol\_f09)

df$Left\_Amygdala\_vol\_f09[(df$outcome == 12)] <- NA

describe(df$Left\_Amygdala\_vol\_f09) # n=3185 participants, match!

describe(df$Right\_Amygdala\_vol\_f09)

df$Right\_Amygdala\_vol\_f09[(df$outcome == 12)] <- NA

describe(df$Right\_Amygdala\_vol\_f09) # n=3185 participants, match!

describe(df$Left\_Hippocampus\_vol\_f09)

df$Left\_Hippocampus\_vol\_f09[(df$outcome == 12)] <- NA

describe(df$Left\_Hippocampus\_vol\_f09) # n=3185 participants, match!

describe(df$Right\_Hippocampus\_vol\_f09)

df$Right\_Hippocampus\_vol\_f09[(df$outcome == 12)] <- NA

describe(df$Right\_Hippocampus\_vol\_f09) # n=3185 participants, match!

# To delete brain data at 13 if they are not of quality

table(df$outcome13) # n=2165 participants

describe(df$CortexVol\_f13)

df$CortexVol\_f13[(df$outcome == 8)] <- NA

describe(df$CortexVol\_f13) # n=2165 participants, match!

describe(df$SubCortGrayVol\_f13)

df$SubCortGrayVol\_f13[(df$outcome == 8)] <- NA

describe(df$SubCortGrayVol\_f13) # n=2165 participants, match!

describe(df$eTIV\_f13)

df$eTIV\_f13[(df$outcome == 8)] <- NA

describe(df$eTIV\_f13) # n=2165 participants, match!

describe(df$CerebralWhiteMatterVol\_f13)

df$CerebralWhiteMatterVol\_f13[(df$outcome == 8)] <- NA

describe(df$CerebralWhiteMatterVol\_f13) # n=2165 participants, match!

describe(df$Left\_Amygdala\_vol\_f13)

df$Left\_Amygdala\_vol\_f13[(df$outcome == 8)] <- NA

describe(df$Left\_Amygdala\_vol\_f13) # n=2139 participants, match!

describe(df$Right\_Amygdala\_vol\_f13)

df$Right\_Amygdala\_vol\_f13[(df$outcome == 8)] <- NA

describe(df$Right\_Amygdala\_vol\_f13) # n=2165 participants, match!

describe(df$Left\_Hippocampus\_vol\_f13)

df$Left\_Hippocampus\_vol\_f13[(df$outcome == 8)] <- NA

describe(df$Left\_Hippocampus\_vol\_f13) # n=2165 participants, match!

describe(df$Right\_Hippocampus\_vol\_f13)

df$Right\_Hippocampus\_vol\_f13[(df$outcome == 8)] <- NA

describe(df$Right\_Hippocampus\_vol\_f13) # n=2165 participants, match!

# To compute total volume of ROIs; i.e., right + left hemispheres

df$Amygdala\_t1 <- df$Left\_Amygdala\_vol\_f09 + df$Right\_Amygdala\_vol\_f09

describe(df$Amygdala\_t1) # n=3185 participants, match!

df$Hippocampus\_t1 <- df$Left\_Hippocampus\_vol\_f09 + df$Right\_Hippocampus\_vol\_f09

describe(df$Hippocampus\_t1) # n=3185 participants, match!

df$Amygdala\_t2 <- df$Left\_Amygdala\_vol\_f13 + df$Right\_Amygdala\_vol\_f13

describe(df$Amygdala\_t2) # n=2165 participants, match!

df$Hippocampus\_t2 <- df$Left\_Hippocampus\_vol\_f13 + df$Right\_Hippocampus\_vol\_f13

describe(df$Hippocampus\_t2) # n=2165 participants, match!

# step 4. Participants with, at least, 1 score for the physical activity exposures (from 4121 to 3502, n=619)

df$has\_exposure\_child <- ifelse((df$PAchildTOTAL >= 0) | (df$PAchildSPORT >= 0) | (df$PAchildPLAY >= 0), 2, 0)

df$has\_exposure\_child[is.na(df$has\_exposure\_child)] <- 0

table(df$has\_exposure\_child) # 3097 participants have self-reported physical activity

df$has\_exposure\_maternal <- ifelse((df$PAparentTOTAL >= 0) | (df$PAparentSPORT >= 0) | (df$PAparentPLAY >= 0), 1, 0)

df$has\_exposure\_maternal[is.na(df$has\_exposure\_maternal)] <- 0

table(df$has\_exposure\_maternal) # 3360 participants have maternal reports of physical activity

df$has\_exposure <- df$has\_exposure\_maternal + df$has\_exposure\_child

table(df$has\_exposure) # Physical activity from maternal report only (n=405), children report only (n=142) and both (n=2955)

df <- subset(df, (has\_exposure > 0))

table(is.na(df$PAchildTOTAL)) # data for 2621 / 881 missing

table(is.na(df$PAchildSPORT)) # data for 2689 / 813 missing

table(is.na(df$PAchildPLAY)) # data for 3029 / 473 missing

table(is.na(df$PAparentTOTAL)) # data for 2933 / 569 missing

table(is.na(df$PAparentSPORT)) # data for 3054 / 448 missing

table(is.na(df$PAparentPLAY)) # data for 3239 / 263 missing

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### If one of the reporter is missing, took the another reporter data

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table(is.na(df$PAchildTOTAL))

describe(df$PAchildTOTAL) # data for 2621, match!

table((df$PAchildTOTAL >= 0) | (df$PAparentTOTAL >= 0)) # data for 3163

df$PAchildTOTAL\_imp <- ifelse(is.na(df$PAchildTOTAL), df$PAparentTOTAL, df$PAchildTOTAL)

table(is.na(df$PAchildTOTAL\_imp)) # data for 3163, match!

describe(df$PAchildTOTAL\_imp)

table(is.na(df$PAchildSPORT))

describe(df$PAchildSPORT) # data for 2689

table((df$PAchildSPORT >= 0) | (df$PAparentSPORT >= 0)) # data for 3195

df$PAchildSPORT\_imp <- ifelse(is.na(df$PAchildSPORT), df$PAparentSPORT, df$PAchildSPORT)

table(is.na(df$PAchildSPORT\_imp)) # data for 3195, match!

describe(df$PAchildSPORT\_imp)

table(is.na(df$PAchildPLAY))

describe(df$PAchildPLAY) # data for 3029

table((df$PAchildPLAY >= 0) | (df$PAparentPLAY >= 0)) # data for 3475

df$PAchildPLAY\_imp <- ifelse(is.na(df$PAchildPLAY), df$PAparentPLAY, df$PAchildPLAY)

table(is.na(df$PAchildPLAY\_imp)) # data for 3475, match!

table(is.na(df$PAparentTOTAL))

describe(df$PAparentTOTAL) # data for 2933

table((df$PAparentTOTAL >= 0) | (df$PAchildTOTAL >= 0)) # data for 3163

df$PAparentTOTAL\_imp <- ifelse(is.na(df$PAparentTOTAL), df$PAchildTOTAL, df$PAparentTOTAL)

table(is.na(df$PAparentTOTAL\_imp)) # data for 3163, match

describe(df$PAparentTOTAL\_imp)

table(is.na(df$PAparentSPORT))

describe(df$PAparentSPORT) # data for 3054

table((df$PAparentSPORT >= 0) | (df$PAchildSPORT >= 0)) # data for 3195

df$PAparentSPORT\_imp <- ifelse(is.na(df$PAparentSPORT), df$PAchildSPORT, df$PAparentSPORT)

table(is.na(df$PAparentSPORT\_imp)) # data for 3195

describe(df$PAparentSPORT\_imp)

table(is.na(df$PAparentPLAY))

describe(df$PAparentPLAY) # data for 3239

table((df$PAparentPLAY >= 0) | (df$PAchildPLAY >= 0)) # data for 3475

df$PAparentPLAY\_imp <- ifelse(is.na(df$PAparentPLAY), df$PAchildPLAY, df$PAparentPLAY)

table(is.na(df$PAparentPLAY\_imp)) # data for 3475

describe(df$PAparentPLAY\_imp)

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### Adding self-reported and maternal report of PA

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df$PAbothTOTAL <- (df$PAchildTOTAL\_imp + df$PAparentTOTAL\_imp) / 2

describe(df$PAbothTOTAL) # data for 3163, which matches the number of imputed maternal and child reports

df$PAbothSPORT <- (df$PAchildSPORT\_imp + df$PAparentSPORT\_imp) / 2

describe(df$PAbothSPORT) # data for 3195, which matches the number of imputed maternal and child reports

df$PAbothPLAY <- (df$PAchildPLAY\_imp + df$PAparentPLAY\_imp) / 2

describe(df$PAbothPLAY) # data for 3475, which matches the number of imputed maternal and child reports

## step 2. Randomly exclude twins, except one (from 3502 to 3459; n=43)

table(df$TWIN)

sum(is.na(df$TWIN))

set.seed(2022)

keeptwins <- subset(df, df$TWIN==1)

#Randomly order data

keeptwins <- keeptwins[sample(nrow(keeptwins)),]

#Delete twins, except first one

keeptwins <- keeptwins[!duplicated(keeptwins$IDM),]

#Check that it worked out: no IDM is repeated

n\_occur <- data.frame(table(keeptwins$IDM))

n\_occur[n\_occur$Freq > 1,]

#Delete twins from df

df <- subset(df, df$TWIN==0)

# Merge selected twins from keeptwins to df

df <- rbind(df, keeptwins)

n\_occur <- data.frame(table(df$IDC))

n\_occur[n\_occur$Freq > 1,]

# The final sample now (7-nov-2022) is 3459, I kept more participants by excluding twins at the end of the selection

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###### The final FULL sample (sensitivity analyses) is 3,459; for main analyses, see, line XXX ####

#### I compare those with MRI at (i) baseline only vs (ii) those with follow up (either having both or only follow-up)

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df$outcome\_binary <- 0

table(df$outcome\_binary)

df$outcome\_binary <- ifelse(df$outcome==8, 1,

ifelse(df$outcome==12, 1,

ifelse(df$outcome==20, 2, NA)))

table(df$outcome\_binary) # 2371 has brain at 9 and 1088 has brain at 13

t.test(df$age\_child\_mri\_f09 ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$bmichild9 ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAchildTOTAL ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAparentTOTAL ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAbothTOTAL ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAchildSPORT ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAparentTOTAL ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAbothSPORT ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAchildPLAY ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAparentPLAY ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$PAbothPLAY ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$eTIV\_f09 ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$CortexVol\_f09 ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$SubCortGrayVol\_f09 ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$CerebralWhiteMatterVol\_f09 ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$Amygdala\_t1 ~ df$outcome\_binary, data = df, var.equal = TRUE)

t.test(df$Hippocampus\_t1 ~ df$outcome\_binary, data = df, var.equal = TRUE)

chisq.test(df$GENDER, df$outcome\_binary)

chisq.test(df$ethn, df$outcome\_binary)

chisq.test(df$edu, df$outcome\_binary) # Only one significant difference (p-value = 0.01409)

chisq <- chisq.test(df$edu, df$outcome\_binary) #

chisq$observed

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######## Table 1. Description of the participants (sensitivity analyses with full sample) ########

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library(summarytools)

## Descriptives at 9

df9 <- subset(df, (outcome == 8 | outcome == 20))

dfSummary(df9$age\_child\_mri\_f09)

dfSummary(df9$age\_child\_mri\_f13)

dfSummary(df9$bmichild9)

describe(df9$GENDER)

describe(df9$ethn)

describe(df9$edu)

dfSummary(df9$season\_careg)

dfSummary(df9$season\_child)

dfSummary(df9$PAchildSPORT)

dfSummary(df9$PAparentSPORT)

dfSummary(df9$PAbothSPORT)

dfSummary(df9$PAchildPLAY)

dfSummary(df9$PAparentPLAY)

dfSummary(df9$PAbothPLAY)

dfSummary(df9$PAchildTOTAL)

dfSummary(df9$PAparentTOTAL)

dfSummary(df9$PAbothTOTAL)

## Descriptives at 13

df13 <- subset(df, (outcome == 12 | outcome == 20))

dfSummary(df13$age\_child\_mri\_f09)

dfSummary(df13$age\_child\_mri\_f13)

dfSummary(df13$bmichild9)

describe(df13$GENDER)

describe(df13$ethn)

describe(df13$edu)

dfSummary(df9$season\_careg)

dfSummary(df9$season\_child)

dfSummary(df13$PAchildSPORT)

dfSummary(df13$PAparentSPORT)

dfSummary(df13$PAbothSPORT)

dfSummary(df13$PAchildPLAY)

dfSummary(df13$PAparentPLAY)

dfSummary(df13$PAbothPLAY)

dfSummary(df13$PAchildTOTAL)

dfSummary(df13$PAparentTOTAL)

dfSummary(df13$PAbothTOTAL)

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######## Table 1. Description of the participants (main analyses with cc) ########

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dd\_b\_cc\_descriptives <- subset(df, (df$CortexVol\_f09 >= 0 & df$SubCortGrayVol\_f09 >= 0 & df$CerebralWhiteMatterVol\_f09 >= 0 &

df$Hippocampus\_t1 >= 0 & df$Amygdala\_t1 >= 0 &

df$CortexVol\_f13 >= 0 & df$SubCortGrayVol\_f13 >= 0 & df$CerebralWhiteMatterVol\_f13 >= 0 &

df$Hippocampus\_t2 >= 0 & df$Amygdala\_t2 >= 0)) # (n=1088), correct!

table(dd\_b\_cc\_descriptives$PAbothSPORT >= 0 | dd\_b\_cc\_descriptives$PAbothPLAY >= 0 | dd\_b\_cc\_descriptives$PAbothTOTAL >= 0) # (n=1088), correct!

dd\_b\_cc\_descriptives

dfSummary(dd\_b\_cc\_descriptives$age\_child\_mri\_f09)

dfSummary(dd\_b\_cc\_descriptives$age\_child\_mri\_f13)

dfSummary(dd\_b\_cc\_descriptives$bmichild9)

describe(dd\_b\_cc\_descriptives$GENDER)

describe(dd\_b\_cc\_descriptives$ethn)

describe(dd\_b\_cc\_descriptives$edu)

describe(dd\_b\_cc\_descriptives$season\_careg)

describe(dd\_b\_cc\_descriptives$season\_child)

dfSummary(dd\_b\_cc\_descriptives$PAchildSPORT)

dfSummary(dd\_b\_cc\_descriptives$PAparentSPORT)

dfSummary(dd\_b\_cc\_descriptives$PAbothSPORT)

dfSummary(dd\_b\_cc\_descriptives$PAchildPLAY)

dfSummary(dd\_b\_cc\_descriptives$PAparentPLAY)

dfSummary(dd\_b\_cc\_descriptives$PAbothPLAY)

dfSummary(dd\_b\_cc\_descriptives$PAchildTOTAL)

dfSummary(dd\_b\_cc\_descriptives$PAparentTOTAL)

dfSummary(dd\_b\_cc\_descriptives$PAbothTOTAL)

############################################################

######## Preparation of df for Linear-mixed model ##########

############################################################

#####

# 0. Prep environment

#####

## 0.1 Load packages

library(foreign)

library(tidyverse)

library(dplyr)

library("psych")

library(Hmisc)

library('tidyr')

library(mice)

library(lme4)

library(car)

library(broom.mixed)

# Rename variables so the only ones with "\_" are those with repeated measures ("\_t1" and "t2"). Important for next step

df <- rename(df, age9 = age\_child\_mri\_f09)

df <- rename(df, eTIV9 = eTIV\_f09)

df <- rename(df, CortexVol\_t1 = CortexVol\_f09)

df <- rename(df, SubCortGrayVol\_t1 = SubCortGrayVol\_f09)

df <- rename(df, CerebralWhiteMatterVol\_t1 = CerebralWhiteMatterVol\_f09)

df <- rename(df, CortexVol\_t2 = CortexVol\_f13)

df <- rename(df, SubCortGrayVol\_t2 = SubCortGrayVol\_f13)

df <- rename(df, CerebralWhiteMatterVol\_t2 = CerebralWhiteMatterVol\_f13)

df <- select(df, c("IDC", "CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1",

"Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2",

"Hippocampus\_t2", "Amygdala\_t2",

"PAchildTOTAL", "PAchildSPORT", "PAchildPLAY",

"PAparentTOTAL", "PAparentSPORT", "PAparentPLAY",

"PAbothTOTAL", "PAbothSPORT", "PAbothPLAY",

"age9", "GENDER", "edu", "ethn", "eTIV9", "bmichild9",

"outcome", "season\_careg", "season\_child"))

# Rescaling of eTIV9 to avoid warnings in linear-mixed models

describe(df$eTIV9)

df$eTIV9 <- df$eTIV9 / 1000

describe(df$eTIV9)

##########################################################################################

# ANALYSES FOR CHILD's REPORTS

##########################################################################################

###############

# CHILD's REPORT: FULL SAMPLE (n=3058)

###############

dd\_c\_fs <- select(df, c("IDC", "CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1",

"Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2",

"Hippocampus\_t2", "Amygdala\_t2",

"PAchildSPORT", "PAchildPLAY", "PAchildTOTAL",

"age9", "GENDER", "edu", "ethn", "eTIV9", "bmichild9",

"season\_careg", "season\_child"))

table(dd\_c\_fs$PAchildSPORT >= 0 | dd\_c\_fs$PAchildPLAY >= 0 | dd\_c\_fs$PAchildTOTAL >= 0) # (n=3058), correct!

dd\_c\_fs <- subset(dd\_c\_fs, (dd\_c\_fs$PAchildSPORT >= 0 | dd\_c\_fs$PAchildPLAY >= 0 | dd\_c\_fs$PAchildTOTAL >= 0)) # (n=3058), correct!

## transform from wide format to long format

dd\_c\_fs <- dd\_c\_fs %>% pivot\_longer(

cols = c("CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1", "Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2", "Hippocampus\_t2", "Amygdala\_t2"),

names\_to = c(".value", "t"),

names\_sep = "\_")

dd\_c\_fs$t <- factor(dd\_c\_fs$t) # make t (time) a factor

dd\_c\_fs <- dd\_c\_fs[with(dd\_c\_fs, order(IDC, t)), ] # Order by IDC and time point, important for linear-mixed models

# Imputation

# set the imputation settings

predMat <- quickpred(dd\_c\_fs, exclude = c("IDC")) # prediction matrix

imp0 <- mice(dd\_c\_fs, maxit = 0) # dry run

meth <- imp0$method

# imputation with 30 iterations and 30 datasets

dd\_c\_fs\_imp <- mice(dd\_c\_fs, m=30, maxit = 30, predictorMatrix = predMat, method = meth, seed = 2022)

summary(dd\_c\_fs\_imp) # "pmm" for continuous and "polyreg" for categorical, correct!

## prueba, checking sample size is correct

dd\_c\_fs\_imp\_c3 <- complete(dd\_c\_fs\_imp, 3)

table(is.na(dd\_c\_fs\_imp\_c3$PAchildTOTAL)) # 6116 observations / 2 t = 3058 participants, correct!

############

# CHILD's reports: full sample (n=3058)

############

# Model 1

M1PAchild\_fs\_SPORT\_CortexVol <- with(dd\_c\_fs\_imp, lmer(CortexVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_SPORT\_SubCortGrayVol <- with(dd\_c\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_SPORT\_CerebralWhiteMatterVol <- with(dd\_c\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_SPORT\_Hippocampus <- with(dd\_c\_fs\_imp, lmer(Hippocampus ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_SPORT\_Amygdala <- with(dd\_c\_fs\_imp, lmer(Amygdala ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_PLAY\_CortexVol <- with(dd\_c\_fs\_imp, lmer(CortexVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_PLAY\_SubCortGrayVol <- with(dd\_c\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_PLAY\_CerebralWhiteMatterVol <- with(dd\_c\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_PLAY\_Hippocampus <- with(dd\_c\_fs\_imp, lmer(Hippocampus ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_PLAY\_Amygdala <- with(dd\_c\_fs\_imp, lmer(Amygdala ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_TOTAL\_CortexVol <- with(dd\_c\_fs\_imp, lmer(CortexVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_TOTAL\_SubCortGrayVol <- with(dd\_c\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_c\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_TOTAL\_Hippocampus <- with(dd\_c\_fs\_imp, lmer(Hippocampus ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_c\_fs, REML = F))

M1PAchild\_fs\_TOTAL\_Amygdala <- with(dd\_c\_fs\_imp, lmer(Amygdala ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_c\_fs, REML = F))

all\_M1PAchild\_fs <- list(M1PAchild\_fs\_SPORT\_CortexVol = M1PAchild\_fs\_SPORT\_CortexVol,

M1PAchild\_fs\_SPORT\_SubCortGrayVol = M1PAchild\_fs\_SPORT\_SubCortGrayVol,

M1PAchild\_fs\_SPORT\_CerebralWhiteMatterVol = M1PAchild\_fs\_SPORT\_CerebralWhiteMatterVol,

M1PAchild\_fs\_SPORT\_Hippocampus = M1PAchild\_fs\_SPORT\_Hippocampus,

M1PAchild\_fs\_SPORT\_Amygdala = M1PAchild\_fs\_SPORT\_Amygdala,

M1PAchild\_fs\_PLAY\_CortexVol = M1PAchild\_fs\_PLAY\_CortexVol,

M1PAchild\_fs\_PLAY\_SubCortGrayVol = M1PAchild\_fs\_PLAY\_SubCortGrayVol,

M1PAchild\_fs\_PLAY\_CerebralWhiteMatterVol = M1PAchild\_fs\_PLAY\_CerebralWhiteMatterVol,

M1PAchild\_fs\_PLAY\_Hippocampus = M1PAchild\_fs\_PLAY\_Hippocampus,

M1PAchild\_fs\_PLAY\_Amygdala = M1PAchild\_fs\_PLAY\_Amygdala,

M1PAchild\_fs\_TOTAL\_CortexVol = M1PAchild\_fs\_TOTAL\_CortexVol,

M1PAchild\_fs\_TOTAL\_SubCortGrayVol = M1PAchild\_fs\_TOTAL\_SubCortGrayVol,

M1PAchild\_fs\_TOTAL\_CerebralWhiteMatterVol = M1PAchild\_fs\_TOTAL\_CerebralWhiteMatterVol,

M1PAchild\_fs\_TOTAL\_Hippocampus = M1PAchild\_fs\_TOTAL\_Hippocampus,

M1PAchild\_fs\_TOTAL\_Amygdala = M1PAchild\_fs\_TOTAL\_Amygdala)

out\_all\_M1PAchild\_fs <- lapply(all\_M1PAchild\_fs, function(x) summary(pool(x)))

out\_all\_M1PAchild\_fs

# Model 2

M2PAchild\_fs\_SPORT\_CortexVol <- with(dd\_c\_fs\_imp, lmer(CortexVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_SPORT\_SubCortGrayVol <- with(dd\_c\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_SPORT\_CerebralWhiteMatterVol <- with(dd\_c\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_SPORT\_Hippocampus <- with(dd\_c\_fs\_imp, lmer(Hippocampus ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_SPORT\_Amygdala <- with(dd\_c\_fs\_imp, lmer(Amygdala ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_PLAY\_CortexVol <- with(dd\_c\_fs\_imp, lmer(CortexVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_PLAY\_SubCortGrayVol <- with(dd\_c\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_PLAY\_CerebralWhiteMatterVol <- with(dd\_c\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_PLAY\_Hippocampus <- with(dd\_c\_fs\_imp, lmer(Hippocampus ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_PLAY\_Amygdala <- with(dd\_c\_fs\_imp, lmer(Amygdala ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_TOTAL\_CortexVol <- with(dd\_c\_fs\_imp, lmer(CortexVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_TOTAL\_SubCortGrayVol <- with(dd\_c\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_c\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_TOTAL\_Hippocampus <- with(dd\_c\_fs\_imp, lmer(Hippocampus ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

M2PAchild\_fs\_TOTAL\_Amygdala <- with(dd\_c\_fs\_imp, lmer(Amygdala ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_c\_fs, REML = F))

all\_M2PAchild\_fs <- list(M2PAchild\_fs\_SPORT\_CortexVol = M2PAchild\_fs\_SPORT\_CortexVol,

M2PAchild\_fs\_SPORT\_SubCortGrayVol = M2PAchild\_fs\_SPORT\_SubCortGrayVol,

M2PAchild\_fs\_SPORT\_CerebralWhiteMatterVol = M2PAchild\_fs\_SPORT\_CerebralWhiteMatterVol,

M2PAchild\_fs\_SPORT\_Hippocampus = M2PAchild\_fs\_SPORT\_Hippocampus,

M2PAchild\_fs\_SPORT\_Amygdala = M2PAchild\_fs\_SPORT\_Amygdala,

M2PAchild\_fs\_PLAY\_CortexVol = M2PAchild\_fs\_PLAY\_CortexVol,

M2PAchild\_fs\_PLAY\_SubCortGrayVol = M2PAchild\_fs\_PLAY\_SubCortGrayVol,

M2PAchild\_fs\_PLAY\_CerebralWhiteMatterVol = M2PAchild\_fs\_PLAY\_CerebralWhiteMatterVol,

M2PAchild\_fs\_PLAY\_Hippocampus = M2PAchild\_fs\_PLAY\_Hippocampus,

M2PAchild\_fs\_PLAY\_Amygdala = M2PAchild\_fs\_PLAY\_Amygdala,

M2PAchild\_fs\_TOTAL\_CortexVol = M2PAchild\_fs\_TOTAL\_CortexVol,

M2PAchild\_fs\_TOTAL\_SubCortGrayVol = M2PAchild\_fs\_TOTAL\_SubCortGrayVol,

M2PAchild\_fs\_TOTAL\_CerebralWhiteMatterVol = M2PAchild\_fs\_TOTAL\_CerebralWhiteMatterVol,

M2PAchild\_fs\_TOTAL\_Hippocampus = M2PAchild\_fs\_TOTAL\_Hippocampus,

M2PAchild\_fs\_TOTAL\_Amygdala = M2PAchild\_fs\_TOTAL\_Amygdala)

out\_all\_M2PAchild\_fs <- lapply(all\_M2PAchild\_fs, function(x) summary(pool(x)))

out\_all\_M2PAchild\_fs

###############

# CHILD's REPORTS: REPEATED BRAIN MEASURES SAMPLE (dd\_c\_cc) (n=987)

###############

table(df$CortexVol\_t1 >= 0 & df$SubCortGrayVol\_t1 >= 0 & df$CerebralWhiteMatterVol\_t1 >= 0 &

df$Hippocampus\_t1 >= 0 & df$Amygdala\_t1 >= 0 &

df$CortexVol\_t2 >= 0 & df$SubCortGrayVol\_t2 >= 0 & df$CerebralWhiteMatterVol\_t2 >= 0 &

df$Hippocampus\_t2 >= 0 & df$Amygdala\_t2 >= 0) # (n=1088)

dd\_c\_cc <- subset(df, (df$CortexVol\_t1 >= 0 & df$SubCortGrayVol\_t1 >= 0 & df$CerebralWhiteMatterVol\_t1 >= 0 &

df$Hippocampus\_t1 >= 0 & df$Amygdala\_t1 >= 0 &

df$CortexVol\_t2 >= 0 & df$SubCortGrayVol\_t2 >= 0 & df$CerebralWhiteMatterVol\_t2 >= 0 &

df$Hippocampus\_t2 >= 0 & df$Amygdala\_t2 >= 0)) # (n=1088)

dd\_c\_cc <- select(dd\_c\_cc, c("IDC", "CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1",

"Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2",

"Hippocampus\_t2", "Amygdala\_t2",

"PAchildSPORT", "PAchildPLAY", "PAchildTOTAL",

"age9", "GENDER", "edu", "ethn", "eTIV9", "bmichild9",

"season\_child"))

# Check that all participants have at least one measure of physical activity

table(dd\_c\_cc$PAchildSPORT >= 0 | dd\_c\_cc$PAchildPLAY >= 0 | dd\_c\_cc$PAchildTOTAL >= 0) # (n=987)

dd\_c\_cc <- subset(dd\_c\_cc, (dd\_c\_cc$PAchildSPORT >= 0 | dd\_c\_cc$PAchildPLAY >= 0 | dd\_c\_cc$PAchildTOTAL >= 0)) # (n=987), correct!

describe(dd\_c\_cc$PAchildSPORT) # 872 with data / 115 (12%) missing

describe(dd\_c\_cc$PAchildPLAY) # 916 with data / 26 (3%) missing

## transform from wide format to long format

dd\_c\_cc <- dd\_c\_cc %>% pivot\_longer(

cols = c("CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1", "Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2", "Hippocampus\_t2", "Amygdala\_t2"),

names\_to = c(".value", "t"),

names\_sep = "\_")

dd\_c\_cc$t <- factor(dd\_c\_cc$t) # make t (time) a factor

dd\_c\_cc <- dd\_c\_cc[with(dd\_c\_cc, order(IDC, t)), ] # Order by IDC and time point, important for linear-mixed models

# Imputation

# set the imputation settings

predMat <- quickpred(dd\_c\_cc, exclude = c("IDC")) # prediction matrix

imp0 <- mice(dd\_c\_cc, maxit = 0) # dry run

meth <- imp0$method

# imputation with 30 iterations and 30 datasets

dd\_c\_cc\_imp <- mice(dd\_c\_cc, m=30, maxit = 30, predictorMatrix = predMat, method = meth, seed = 2022)

summary(dd\_c\_cc\_imp) # "pmm" for continuous and "polyreg" for categorical, correct!

## prueba, checking sample size is correct

dd\_c\_cc\_imp\_c3 <- complete(dd\_c\_cc\_imp, 3)

table(is.na(dd\_c\_cc\_imp\_c3$PAchildTOTAL)) # 1974 observations / 2 t = 987 participants, correct!

############

# CHILD's REPORTS: repeated brain measures (n=987)

############

# Model 1:

M1PAchild\_cc\_SPORT\_CortexVol <- with(dd\_c\_cc\_imp, lmer(CortexVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_SPORT\_SubCortGrayVol <- with(dd\_c\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_SPORT\_CerebralWhiteMatterVol <- with(dd\_c\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_SPORT\_Hippocampus <- with(dd\_c\_cc\_imp, lmer(Hippocampus ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_SPORT\_Amygdala <- with(dd\_c\_cc\_imp, lmer(Amygdala ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_PLAY\_CortexVol <- with(dd\_c\_cc\_imp, lmer(CortexVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_PLAY\_SubCortGrayVol <- with(dd\_c\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_PLAY\_CerebralWhiteMatterVol <- with(dd\_c\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_PLAY\_Hippocampus <- with(dd\_c\_cc\_imp, lmer(Hippocampus ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_PLAY\_Amygdala <- with(dd\_c\_cc\_imp, lmer(Amygdala ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_TOTAL\_CortexVol <- with(dd\_c\_cc\_imp, lmer(CortexVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_TOTAL\_SubCortGrayVol <- with(dd\_c\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_c\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_TOTAL\_Hippocampus <- with(dd\_c\_cc\_imp, lmer(Hippocampus ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_child + (1|IDC), dd\_c\_cc, REML = F))

M1PAchild\_cc\_TOTAL\_Amygdala <- with(dd\_c\_cc\_imp, lmer(Amygdala ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_child + (1|IDC), dd\_c\_cc, REML = F))

all\_M1PAchild\_cc <- list(M1PAchild\_cc\_SPORT\_CortexVol = M1PAchild\_cc\_SPORT\_CortexVol,

M1PAchild\_cc\_SPORT\_SubCortGrayVol = M1PAchild\_cc\_SPORT\_SubCortGrayVol,

M1PAchild\_cc\_SPORT\_CerebralWhiteMatterVol = M1PAchild\_cc\_SPORT\_CerebralWhiteMatterVol,

M1PAchild\_cc\_SPORT\_Hippocampus = M1PAchild\_cc\_SPORT\_Hippocampus,

M1PAchild\_cc\_SPORT\_Amygdala = M1PAchild\_cc\_SPORT\_Amygdala,

M1PAchild\_cc\_PLAY\_CortexVol = M1PAchild\_cc\_PLAY\_CortexVol,

M1PAchild\_cc\_PLAY\_SubCortGrayVol = M1PAchild\_cc\_PLAY\_SubCortGrayVol,

M1PAchild\_cc\_PLAY\_CerebralWhiteMatterVol = M1PAchild\_cc\_PLAY\_CerebralWhiteMatterVol,

M1PAchild\_cc\_PLAY\_Hippocampus = M1PAchild\_cc\_PLAY\_Hippocampus,

M1PAchild\_cc\_PLAY\_Amygdala = M1PAchild\_cc\_PLAY\_Amygdala,

M1PAchild\_cc\_TOTAL\_CortexVol = M1PAchild\_cc\_TOTAL\_CortexVol,

M1PAchild\_cc\_TOTAL\_SubCortGrayVol = M1PAchild\_cc\_TOTAL\_SubCortGrayVol,

M1PAchild\_cc\_TOTAL\_CerebralWhiteMatterVol = M1PAchild\_cc\_TOTAL\_CerebralWhiteMatterVol,

M1PAchild\_cc\_TOTAL\_Hippocampus = M1PAchild\_cc\_TOTAL\_Hippocampus,

M1PAchild\_cc\_TOTAL\_Amygdala = M1PAchild\_cc\_TOTAL\_Amygdala)

out\_all\_M1PAchild\_cc <- lapply(all\_M1PAchild\_cc, function(x) summary(pool(x)))

out\_all\_M1PAchild\_cc

# Model 2

M2PAchild\_cc\_SPORT\_CortexVol <- with(dd\_c\_cc\_imp, lmer(CortexVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_SPORT\_SubCortGrayVol <- with(dd\_c\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_SPORT\_CerebralWhiteMatterVol <- with(dd\_c\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_SPORT\_Hippocampus <- with(dd\_c\_cc\_imp, lmer(Hippocampus ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_SPORT\_Amygdala <- with(dd\_c\_cc\_imp, lmer(Amygdala ~ t\*PAchildSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_PLAY\_CortexVol <- with(dd\_c\_cc\_imp, lmer(CortexVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_PLAY\_SubCortGrayVol <- with(dd\_c\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_PLAY\_CerebralWhiteMatterVol <- with(dd\_c\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_PLAY\_Hippocampus <- with(dd\_c\_cc\_imp, lmer(Hippocampus ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_PLAY\_Amygdala <- with(dd\_c\_cc\_imp, lmer(Amygdala ~ t\*PAchildPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_TOTAL\_CortexVol <- with(dd\_c\_cc\_imp, lmer(CortexVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_TOTAL\_SubCortGrayVol <- with(dd\_c\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_c\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_TOTAL\_Hippocampus <- with(dd\_c\_cc\_imp, lmer(Hippocampus ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

M2PAchild\_cc\_TOTAL\_Amygdala <- with(dd\_c\_cc\_imp, lmer(Amygdala ~ t\*PAchildTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_child + bmichild9 + (1|IDC), dd\_c\_cc, REML = F))

all\_M2PAchild\_cc <- list(M2PAchild\_cc\_SPORT\_CortexVol = M2PAchild\_cc\_SPORT\_CortexVol,

M2PAchild\_cc\_SPORT\_SubCortGrayVol = M2PAchild\_cc\_SPORT\_SubCortGrayVol,

M2PAchild\_cc\_SPORT\_CerebralWhiteMatterVol = M2PAchild\_cc\_SPORT\_CerebralWhiteMatterVol,

M2PAchild\_cc\_SPORT\_Hippocampus = M2PAchild\_cc\_SPORT\_Hippocampus,

M2PAchild\_cc\_SPORT\_Amygdala = M2PAchild\_cc\_SPORT\_Amygdala,

M2PAchild\_cc\_PLAY\_CortexVol = M2PAchild\_cc\_PLAY\_CortexVol,

M2PAchild\_cc\_PLAY\_SubCortGrayVol = M2PAchild\_cc\_PLAY\_SubCortGrayVol,

M2PAchild\_cc\_PLAY\_CerebralWhiteMatterVol = M2PAchild\_cc\_PLAY\_CerebralWhiteMatterVol,

M2PAchild\_cc\_PLAY\_Hippocampus = M2PAchild\_cc\_PLAY\_Hippocampus,

M2PAchild\_cc\_PLAY\_Amygdala = M2PAchild\_cc\_PLAY\_Amygdala,

M2PAchild\_cc\_TOTAL\_CortexVol = M2PAchild\_cc\_TOTAL\_CortexVol,

M2PAchild\_cc\_TOTAL\_SubCortGrayVol = M2PAchild\_cc\_TOTAL\_SubCortGrayVol,

M2PAchild\_cc\_TOTAL\_CerebralWhiteMatterVol = M2PAchild\_cc\_TOTAL\_CerebralWhiteMatterVol,

M2PAchild\_cc\_TOTAL\_Hippocampus = M2PAchild\_cc\_TOTAL\_Hippocampus,

M2PAchild\_cc\_TOTAL\_Amygdala = M2PAchild\_cc\_TOTAL\_Amygdala)

out\_all\_M2PAchild\_cc <- lapply(all\_M2PAchild\_cc, function(x) summary(pool(x)))

out\_all\_M2PAchild\_cc

##########################################################################################

# ANALYSES FOR PARENT's REPORTS

##########################################################################################

###############

# PARENT's REPORTS: FULL SAMPLE (n=3317)

###############

dd\_p\_fs <- select(df, c("IDC", "CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1",

"Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2",

"Hippocampus\_t2", "Amygdala\_t2",

"PAparentSPORT", "PAparentPLAY", "PAparentTOTAL",

"age9", "GENDER", "edu", "ethn", "eTIV9", "bmichild9",

"season\_careg"))

table(dd\_p\_fs$PAparentSPORT >= 0 | dd\_p\_fs$PAparentPLAY >= 0 | dd\_p\_fs$PAparentTOTAL >= 0) # (n=3317)

dd\_p\_fs <- subset(dd\_p\_fs, (dd\_p\_fs$PAparentSPORT >= 0 | dd\_p\_fs$PAparentPLAY >= 0 | dd\_p\_fs$PAparentTOTAL >= 0)) # (n=3317), correct!

## transform from wide format to long format

dd\_p\_fs <- dd\_p\_fs %>% pivot\_longer(

cols = c("CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1", "Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2", "Hippocampus\_t2", "Amygdala\_t2"),

names\_to = c(".value", "t"),

names\_sep = "\_")

dd\_p\_fs$t <- factor(dd\_p\_fs$t) # make t (time) a factor

dd\_p\_fs <- dd\_p\_fs[with(dd\_p\_fs, order(IDC, t)), ] # Order by IDC and time point, important for linear-mixed models

# Imputation

# set the imputation settings

predMat <- quickpred(dd\_p\_fs, exclude = c("IDC")) # prediction matrix

imp0 <- mice(dd\_p\_fs, maxit = 0) # dry run

meth <- imp0$method

# imputation with 30 iterations and 30 datasets

dd\_p\_fs\_imp <- mice(dd\_p\_fs, m=30, maxit = 30, predictorMatrix = predMat, method = meth, seed = 2022)

summary(dd\_p\_fs\_imp) # "pmm" for continuous and "polyreg" for categorical, correct!

## prueba, checking sample size is correct

dd\_p\_fs\_imp\_c3 <- complete(dd\_p\_fs\_imp, 3)

table(is.na(dd\_p\_fs\_imp\_c3$PAparentTOTAL)) # 6634 observations / 2 t = 3317 participants, correct!

############

# PARENT's REPORTS: full sample (n=3317)

############

# Model 1

M1PAparent\_fs\_SPORT\_CortexVol <- with(dd\_p\_fs\_imp, lmer(CortexVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_SPORT\_SubCortGrayVol <- with(dd\_p\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_SPORT\_CerebralWhiteMatterVol <- with(dd\_p\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_SPORT\_Hippocampus <- with(dd\_p\_fs\_imp, lmer(Hippocampus ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_SPORT\_Amygdala <- with(dd\_p\_fs\_imp, lmer(Amygdala ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_PLAY\_CortexVol <- with(dd\_p\_fs\_imp, lmer(CortexVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_PLAY\_SubCortGrayVol <- with(dd\_p\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_PLAY\_CerebralWhiteMatterVol <- with(dd\_p\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_PLAY\_Hippocampus <- with(dd\_p\_fs\_imp, lmer(Hippocampus ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_PLAY\_Amygdala <- with(dd\_p\_fs\_imp, lmer(Amygdala ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_TOTAL\_CortexVol <- with(dd\_p\_fs\_imp, lmer(CortexVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_TOTAL\_SubCortGrayVol <- with(dd\_p\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_p\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_TOTAL\_Hippocampus <- with(dd\_p\_fs\_imp, lmer(Hippocampus ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_p\_fs, REML = F))

M1PAparent\_fs\_TOTAL\_Amygdala <- with(dd\_p\_fs\_imp, lmer(Amygdala ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_p\_fs, REML = F))

all\_M1PAparent\_fs <- list(M1PAparent\_fs\_SPORT\_CortexVol = M1PAparent\_fs\_SPORT\_CortexVol,

M1PAparent\_fs\_SPORT\_SubCortGrayVol = M1PAparent\_fs\_SPORT\_SubCortGrayVol,

M1PAparent\_fs\_SPORT\_CerebralWhiteMatterVol = M1PAparent\_fs\_SPORT\_CerebralWhiteMatterVol,

M1PAparent\_fs\_SPORT\_Hippocampus = M1PAparent\_fs\_SPORT\_Hippocampus,

M1PAparent\_fs\_SPORT\_Amygdala = M1PAparent\_fs\_SPORT\_Amygdala,

M1PAparent\_fs\_PLAY\_CortexVol = M1PAparent\_fs\_PLAY\_CortexVol,

M1PAparent\_fs\_PLAY\_SubCortGrayVol = M1PAparent\_fs\_PLAY\_SubCortGrayVol,

M1PAparent\_fs\_PLAY\_CerebralWhiteMatterVol = M1PAparent\_fs\_PLAY\_CerebralWhiteMatterVol,

M1PAparent\_fs\_PLAY\_Hippocampus = M1PAparent\_fs\_PLAY\_Hippocampus,

M1PAparent\_fs\_PLAY\_Amygdala = M1PAparent\_fs\_PLAY\_Amygdala,

M1PAparent\_fs\_TOTAL\_CortexVol = M1PAparent\_fs\_TOTAL\_CortexVol,

M1PAparent\_fs\_TOTAL\_SubCortGrayVol = M1PAparent\_fs\_TOTAL\_SubCortGrayVol,

M1PAparent\_fs\_TOTAL\_CerebralWhiteMatterVol = M1PAparent\_fs\_TOTAL\_CerebralWhiteMatterVol,

M1PAparent\_fs\_TOTAL\_Hippocampus = M1PAparent\_fs\_TOTAL\_Hippocampus,

M1PAparent\_fs\_TOTAL\_Amygdala = M1PAparent\_fs\_TOTAL\_Amygdala)

out\_all\_M1PAparent\_fs <- lapply(all\_M1PAparent\_fs, function(x) summary(pool(x)))

out\_all\_M1PAparent\_fs

# Model 2

M2PAparent\_fs\_SPORT\_CortexVol <- with(dd\_p\_fs\_imp, lmer(CortexVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_SPORT\_SubCortGrayVol <- with(dd\_p\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_SPORT\_CerebralWhiteMatterVol <- with(dd\_p\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_SPORT\_Hippocampus <- with(dd\_p\_fs\_imp, lmer(Hippocampus ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_SPORT\_Amygdala <- with(dd\_p\_fs\_imp, lmer(Amygdala ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_PLAY\_CortexVol <- with(dd\_p\_fs\_imp, lmer(CortexVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_PLAY\_SubCortGrayVol <- with(dd\_p\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_PLAY\_CerebralWhiteMatterVol <- with(dd\_p\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_PLAY\_Hippocampus <- with(dd\_p\_fs\_imp, lmer(Hippocampus ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_PLAY\_Amygdala <- with(dd\_p\_fs\_imp, lmer(Amygdala ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_TOTAL\_CortexVol <- with(dd\_p\_fs\_imp, lmer(CortexVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_TOTAL\_SubCortGrayVol <- with(dd\_p\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_p\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_TOTAL\_Hippocampus <- with(dd\_p\_fs\_imp, lmer(Hippocampus ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

M2PAparent\_fs\_TOTAL\_Amygdala <- with(dd\_p\_fs\_imp, lmer(Amygdala ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_p\_fs, REML = F))

all\_M2PAparent\_fs <- list(M2PAparent\_fs\_SPORT\_CortexVol = M2PAparent\_fs\_SPORT\_CortexVol,

M2PAparent\_fs\_SPORT\_SubCortGrayVol = M2PAparent\_fs\_SPORT\_SubCortGrayVol,

M2PAparent\_fs\_SPORT\_CerebralWhiteMatterVol = M2PAparent\_fs\_SPORT\_CerebralWhiteMatterVol,

M2PAparent\_fs\_SPORT\_Hippocampus = M2PAparent\_fs\_SPORT\_Hippocampus,

M2PAparent\_fs\_SPORT\_Amygdala = M2PAparent\_fs\_SPORT\_Amygdala,

M2PAparent\_fs\_PLAY\_CortexVol = M2PAparent\_fs\_PLAY\_CortexVol,

M2PAparent\_fs\_PLAY\_SubCortGrayVol = M2PAparent\_fs\_PLAY\_SubCortGrayVol,

M2PAparent\_fs\_PLAY\_CerebralWhiteMatterVol = M2PAparent\_fs\_PLAY\_CerebralWhiteMatterVol,

M2PAparent\_fs\_PLAY\_Hippocampus = M2PAparent\_fs\_PLAY\_Hippocampus,

M2PAparent\_fs\_PLAY\_Amygdala = M2PAparent\_fs\_PLAY\_Amygdala,

M2PAparent\_fs\_TOTAL\_CortexVol = M2PAparent\_fs\_TOTAL\_CortexVol,

M2PAparent\_fs\_TOTAL\_SubCortGrayVol = M2PAparent\_fs\_TOTAL\_SubCortGrayVol,

M2PAparent\_fs\_TOTAL\_CerebralWhiteMatterVol = M2PAparent\_fs\_TOTAL\_CerebralWhiteMatterVol,

M2PAparent\_fs\_TOTAL\_Hippocampus = M2PAparent\_fs\_TOTAL\_Hippocampus,

M2PAparent\_fs\_TOTAL\_Amygdala = M2PAparent\_fs\_TOTAL\_Amygdala)

out\_all\_M2PAparent\_fs <- lapply(all\_M2PAparent\_fs, function(x) summary(pool(x)))

out\_all\_M2PAparent\_fs

###############

# PARENT's REPORTS: REPEATED BRAIN MEASURES SAMPLE (dd\_p\_cc) (n=1052)

###############

table(df$CortexVol\_t1 >= 0 & df$SubCortGrayVol\_t1 >= 0 & df$CerebralWhiteMatterVol\_t1 >= 0 &

df$Hippocampus\_t1 >= 0 & df$Amygdala\_t1 >= 0 &

df$CortexVol\_t2 >= 0 & df$SubCortGrayVol\_t2 >= 0 & df$CerebralWhiteMatterVol\_t2 >= 0 &

df$Hippocampus\_t2 >= 0 & df$Amygdala\_t2 >= 0) # (n=1088)

dd\_p\_cc <- subset(df, (df$CortexVol\_t1 >= 0 & df$SubCortGrayVol\_t1 >= 0 & df$CerebralWhiteMatterVol\_t1 >= 0 &

df$Hippocampus\_t1 >= 0 & df$Amygdala\_t1 >= 0 &

df$CortexVol\_t2 >= 0 & df$SubCortGrayVol\_t2 >= 0 & df$CerebralWhiteMatterVol\_t2 >= 0 &

df$Hippocampus\_t2 >= 0 & df$Amygdala\_t2 >= 0)) # (n=1088)

table(dd\_p\_cc$PAparentSPORT >= 0 | dd\_p\_cc$PAparentPLAY >= 0 | dd\_p\_cc$PAparentTOTAL >= 0) # (n=1052)

dd\_p\_cc <- subset(dd\_p\_cc, (dd\_p\_cc$PAparentSPORT >= 0 | dd\_p\_cc$PAparentPLAY >= 0 | dd\_p\_cc$PAparentTOTAL >= 0)) # (n=1052), correct!

dd\_p\_cc <- select(dd\_p\_cc, c("IDC", "CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1",

"Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2",

"Hippocampus\_t2", "Amygdala\_t2",

"PAparentSPORT", "PAparentPLAY", "PAparentTOTAL",

"age9", "GENDER", "edu", "ethn", "eTIV9", "bmichild9",

"season\_careg"))

# Check that all participants have at least one measure of physical activity

table(dd\_p\_cc$PAparentSPORT >= 0 | dd\_p\_cc$PAparentPLAY >= 0 | dd\_p\_cc$PAparentTOTAL >= 0) # (n=1052)

dd\_p\_cc <- subset(dd\_p\_cc, (dd\_p\_cc$PAparentSPORT >= 0 | dd\_p\_cc$PAparentPLAY >= 0 | dd\_p\_cc$PAparentTOTAL >= 0)) # (n=1052), correct!

describe(dd\_p\_cc$PAparentSPORT) # 971 with data / 81 (8%) missing

describe(dd\_p\_cc$PAparentPLAY) # 1012 with data / 40 (4%) missing

## transform from wide format to long format

dd\_p\_cc <- dd\_p\_cc %>% pivot\_longer(

cols = c("CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1", "Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2", "Hippocampus\_t2", "Amygdala\_t2"),

names\_to = c(".value", "t"),

names\_sep = "\_")

dd\_p\_cc$t <- factor(dd\_p\_cc$t) # make t (time) a factor

dd\_p\_cc <- dd\_p\_cc[with(dd\_p\_cc, order(IDC, t)), ] # Order by IDC and time point, important for linear-mixed models

# Imputation

# set the imputation settings

predMat <- quickpred(dd\_p\_cc, exclude = c("IDC")) # prediction matrix

imp0 <- mice(dd\_p\_cc, maxit = 0) # dry run

meth <- imp0$method

# imputation with 30 iterations and 30 datasets

dd\_p\_cc\_imp <- mice(dd\_p\_cc, m=30, maxit = 30, predictorMatrix = predMat, method = meth, seed = 2022)

summary(dd\_p\_cc\_imp) # "pmm" for continuous and "polyreg" for categorical, correct!

## prueba, checking sample size is correct

dd\_p\_cc\_imp\_c3 <- complete(dd\_p\_cc\_imp, 3)

table(is.na(dd\_p\_cc\_imp\_c3$PAparentTOTAL)) # 2104 observations / 2 t = 1052 participants, correct!

############

# PARENT's REPORTS: Analyses: repeated brain measures (n=1052)

############

# Model 1:

M1PAparent\_cc\_SPORT\_CortexVol <- with(dd\_p\_cc\_imp, lmer(CortexVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_SPORT\_SubCortGrayVol <- with(dd\_p\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_SPORT\_CerebralWhiteMatterVol <- with(dd\_p\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_SPORT\_Hippocampus <- with(dd\_p\_cc\_imp, lmer(Hippocampus ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_SPORT\_Amygdala <- with(dd\_p\_cc\_imp, lmer(Amygdala ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_PLAY\_CortexVol <- with(dd\_p\_cc\_imp, lmer(CortexVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_PLAY\_SubCortGrayVol <- with(dd\_p\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_PLAY\_CerebralWhiteMatterVol <- with(dd\_p\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_PLAY\_Hippocampus <- with(dd\_p\_cc\_imp, lmer(Hippocampus ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_PLAY\_Amygdala <- with(dd\_p\_cc\_imp, lmer(Amygdala ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_TOTAL\_CortexVol <- with(dd\_p\_cc\_imp, lmer(CortexVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_TOTAL\_SubCortGrayVol <- with(dd\_p\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_p\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_TOTAL\_Hippocampus <- with(dd\_p\_cc\_imp, lmer(Hippocampus ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

M1PAparent\_cc\_TOTAL\_Amygdala <- with(dd\_p\_cc\_imp, lmer(Amygdala ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_p\_cc, REML = F))

all\_M1PAparent\_cc <- list(M1PAparent\_cc\_SPORT\_CortexVol = M1PAparent\_cc\_SPORT\_CortexVol,

M1PAparent\_cc\_SPORT\_SubCortGrayVol = M1PAparent\_cc\_SPORT\_SubCortGrayVol,

M1PAparent\_cc\_SPORT\_CerebralWhiteMatterVol = M1PAparent\_cc\_SPORT\_CerebralWhiteMatterVol,

M1PAparent\_cc\_SPORT\_Hippocampus = M1PAparent\_cc\_SPORT\_Hippocampus,

M1PAparent\_cc\_SPORT\_Amygdala = M1PAparent\_cc\_SPORT\_Amygdala,

M1PAparent\_cc\_PLAY\_CortexVol = M1PAparent\_cc\_PLAY\_CortexVol,

M1PAparent\_cc\_PLAY\_SubCortGrayVol = M1PAparent\_cc\_PLAY\_SubCortGrayVol,

M1PAparent\_cc\_PLAY\_CerebralWhiteMatterVol = M1PAparent\_cc\_PLAY\_CerebralWhiteMatterVol,

M1PAparent\_cc\_PLAY\_Hippocampus = M1PAparent\_cc\_PLAY\_Hippocampus,

M1PAparent\_cc\_PLAY\_Amygdala = M1PAparent\_cc\_PLAY\_Amygdala,

M1PAparent\_cc\_TOTAL\_CortexVol = M1PAparent\_cc\_TOTAL\_CortexVol,

M1PAparent\_cc\_TOTAL\_SubCortGrayVol = M1PAparent\_cc\_TOTAL\_SubCortGrayVol,

M1PAparent\_cc\_TOTAL\_CerebralWhiteMatterVol = M1PAparent\_cc\_TOTAL\_CerebralWhiteMatterVol,

M1PAparent\_cc\_TOTAL\_Hippocampus = M1PAparent\_cc\_TOTAL\_Hippocampus,

M1PAparent\_cc\_TOTAL\_Amygdala = M1PAparent\_cc\_TOTAL\_Amygdala)

out\_all\_M1PAparent\_cc <- lapply(all\_M1PAparent\_cc, function(x) summary(pool(x)))

out\_all\_M1PAparent\_cc

# Model 2

M2PAparent\_cc\_SPORT\_CortexVol <- with(dd\_p\_cc\_imp, lmer(CortexVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_SPORT\_SubCortGrayVol <- with(dd\_p\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_SPORT\_CerebralWhiteMatterVol <- with(dd\_p\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_SPORT\_Hippocampus <- with(dd\_p\_cc\_imp, lmer(Hippocampus ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_SPORT\_Amygdala <- with(dd\_p\_cc\_imp, lmer(Amygdala ~ t\*PAparentSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_PLAY\_CortexVol <- with(dd\_p\_cc\_imp, lmer(CortexVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_PLAY\_SubCortGrayVol <- with(dd\_p\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_PLAY\_CerebralWhiteMatterVol <- with(dd\_p\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_PLAY\_Hippocampus <- with(dd\_p\_cc\_imp, lmer(Hippocampus ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_PLAY\_Amygdala <- with(dd\_p\_cc\_imp, lmer(Amygdala ~ t\*PAparentPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_TOTAL\_CortexVol <- with(dd\_p\_cc\_imp, lmer(CortexVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_TOTAL\_SubCortGrayVol <- with(dd\_p\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_p\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_TOTAL\_Hippocampus <- with(dd\_p\_cc\_imp, lmer(Hippocampus ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

M2PAparent\_cc\_TOTAL\_Amygdala <- with(dd\_p\_cc\_imp, lmer(Amygdala ~ t\*PAparentTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_p\_cc, REML = F))

all\_M2PAparent\_cc <- list(M2PAparent\_cc\_SPORT\_CortexVol = M2PAparent\_cc\_SPORT\_CortexVol,

M2PAparent\_cc\_SPORT\_SubCortGrayVol = M2PAparent\_cc\_SPORT\_SubCortGrayVol,

M2PAparent\_cc\_SPORT\_CerebralWhiteMatterVol = M2PAparent\_cc\_SPORT\_CerebralWhiteMatterVol,

M2PAparent\_cc\_SPORT\_Hippocampus = M2PAparent\_cc\_SPORT\_Hippocampus,

M2PAparent\_cc\_SPORT\_Amygdala = M2PAparent\_cc\_SPORT\_Amygdala,

M2PAparent\_cc\_PLAY\_CortexVol = M2PAparent\_cc\_PLAY\_CortexVol,

M2PAparent\_cc\_PLAY\_SubCortGrayVol = M2PAparent\_cc\_PLAY\_SubCortGrayVol,

M2PAparent\_cc\_PLAY\_CerebralWhiteMatterVol = M2PAparent\_cc\_PLAY\_CerebralWhiteMatterVol,

M2PAparent\_cc\_PLAY\_Hippocampus = M2PAparent\_cc\_PLAY\_Hippocampus,

M2PAparent\_cc\_PLAY\_Amygdala = M2PAparent\_cc\_PLAY\_Amygdala,

M2PAparent\_cc\_TOTAL\_CortexVol = M2PAparent\_cc\_TOTAL\_CortexVol,

M2PAparent\_cc\_TOTAL\_SubCortGrayVol = M2PAparent\_cc\_TOTAL\_SubCortGrayVol,

M2PAparent\_cc\_TOTAL\_CerebralWhiteMatterVol = M2PAparent\_cc\_TOTAL\_CerebralWhiteMatterVol,

M2PAparent\_cc\_TOTAL\_Hippocampus = M2PAparent\_cc\_TOTAL\_Hippocampus,

M2PAparent\_cc\_TOTAL\_Amygdala = M2PAparent\_cc\_TOTAL\_Amygdala)

out\_all\_M2PAparent\_cc <- lapply(all\_M2PAparent\_cc, function(x) summary(pool(x)))

out\_all\_M2PAparent\_cc

##########################################################################################

# ANALYSES FOR BOTH REPORTS

##########################################################################################

###############

# BOTH REPORTS: FULL SAMPLE (n=3459)

###############

dd\_b\_fs <- select(df, c("IDC", "CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1",

"Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2",

"Hippocampus\_t2", "Amygdala\_t2",

"PAbothSPORT", "PAbothPLAY", "PAbothTOTAL",

"age9", "GENDER", "edu", "ethn", "eTIV9", "bmichild9",

"season\_child"))

# Check that all participants have at least one measure of physical activity (n=3459)

table(dd\_b\_fs$PAbothSPORT >= 0 | dd\_b\_fs$PAbothPLAY >= 0 | dd\_b\_fs$PAbothTOTAL >= 0) # (n=3459), correct!

## transform from wide format to long format

dd\_b\_fs <- dd\_b\_fs %>% pivot\_longer(

cols = c("CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1", "Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2", "Hippocampus\_t2", "Amygdala\_t2"),

names\_to = c(".value", "t"),

names\_sep = "\_")

dd\_b\_fs$t <- factor(dd\_b\_fs$t) # make t (time) a factor

dd\_b\_fs <- dd\_b\_fs[with(dd\_b\_fs, order(IDC, t)), ] # Order by IDC and time point, important for linear-mixed models

# Imputation

# set the imputation settings

predMat <- quickpred(dd\_b\_fs, exclude = c("IDC")) # prediction matrix

imp0 <- mice(dd\_b\_fs, maxit = 0) # dry run

meth <- imp0$method

# imputation with 30 iterations and 30 datasets

dd\_b\_fs\_imp <- mice(dd\_b\_fs, m=30, maxit = 30, predictorMatrix = predMat, method = meth, seed = 2022)

summary(dd\_b\_fs\_imp) # "pmm" for continuous and "polyreg" for categorical, correct!

## prueba, checking sample size is correct

dd\_b\_fs\_imp\_c3 <- complete(dd\_b\_fs\_imp, 3)

table(is.na(dd\_b\_fs\_imp\_c3$PAbothTOTAL)) # 6918 observations / 2 t = 3459 participants, correct!

############

# BOTH REPORTS: Analyses: full sample (n=3459)

############

# Model 1

M1PAboth\_fs\_SPORT\_CortexVol <- with(dd\_b\_fs\_imp, lmer(CortexVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_SPORT\_SubCortGrayVol <- with(dd\_b\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_SPORT\_CerebralWhiteMatterVol <- with(dd\_b\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_SPORT\_Hippocampus <- with(dd\_b\_fs\_imp, lmer(Hippocampus ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_SPORT\_Amygdala <- with(dd\_b\_fs\_imp, lmer(Amygdala ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_PLAY\_CortexVol <- with(dd\_b\_fs\_imp, lmer(CortexVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_PLAY\_SubCortGrayVol <- with(dd\_b\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_PLAY\_CerebralWhiteMatterVol <- with(dd\_b\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_PLAY\_Hippocampus <- with(dd\_b\_fs\_imp, lmer(Hippocampus ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_PLAY\_Amygdala <- with(dd\_b\_fs\_imp, lmer(Amygdala ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_TOTAL\_CortexVol <- with(dd\_b\_fs\_imp, lmer(CortexVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_TOTAL\_SubCortGrayVol <- with(dd\_b\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_b\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_TOTAL\_Hippocampus <- with(dd\_b\_fs\_imp, lmer(Hippocampus ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_b\_fs, REML = F))

M1PAboth\_fs\_TOTAL\_Amygdala <- with(dd\_b\_fs\_imp, lmer(Amygdala ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + (1|IDC), dd\_b\_fs, REML = F))

all\_M1PAboth\_fs <- list(M1PAboth\_fs\_SPORT\_CortexVol = M1PAboth\_fs\_SPORT\_CortexVol,

M1PAboth\_fs\_SPORT\_SubCortGrayVol = M1PAboth\_fs\_SPORT\_SubCortGrayVol,

M1PAboth\_fs\_SPORT\_CerebralWhiteMatterVol = M1PAboth\_fs\_SPORT\_CerebralWhiteMatterVol,

M1PAboth\_fs\_SPORT\_Hippocampus = M1PAboth\_fs\_SPORT\_Hippocampus,

M1PAboth\_fs\_SPORT\_Amygdala = M1PAboth\_fs\_SPORT\_Amygdala,

M1PAboth\_fs\_PLAY\_CortexVol = M1PAboth\_fs\_PLAY\_CortexVol,

M1PAboth\_fs\_PLAY\_SubCortGrayVol = M1PAboth\_fs\_PLAY\_SubCortGrayVol,

M1PAboth\_fs\_PLAY\_CerebralWhiteMatterVol = M1PAboth\_fs\_PLAY\_CerebralWhiteMatterVol,

M1PAboth\_fs\_PLAY\_Hippocampus = M1PAboth\_fs\_PLAY\_Hippocampus,

M1PAboth\_fs\_PLAY\_Amygdala = M1PAboth\_fs\_PLAY\_Amygdala,

M1PAboth\_fs\_TOTAL\_CortexVol = M1PAboth\_fs\_TOTAL\_CortexVol,

M1PAboth\_fs\_TOTAL\_SubCortGrayVol = M1PAboth\_fs\_TOTAL\_SubCortGrayVol,

M1PAboth\_fs\_TOTAL\_CerebralWhiteMatterVol = M1PAboth\_fs\_TOTAL\_CerebralWhiteMatterVol,

M1PAboth\_fs\_TOTAL\_Hippocampus = M1PAboth\_fs\_TOTAL\_Hippocampus,

M1PAboth\_fs\_TOTAL\_Amygdala = M1PAboth\_fs\_TOTAL\_Amygdala)

out\_all\_M1PAboth\_fs <- lapply(all\_M1PAboth\_fs, function(x) summary(pool(x)))

out\_all\_M1PAboth\_fs

# Model 2

M2PAboth\_fs\_SPORT\_CortexVol <- with(dd\_b\_fs\_imp, lmer(CortexVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_SPORT\_SubCortGrayVol <- with(dd\_b\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_SPORT\_CerebralWhiteMatterVol <- with(dd\_b\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_SPORT\_Hippocampus <- with(dd\_b\_fs\_imp, lmer(Hippocampus ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_SPORT\_Amygdala <- with(dd\_b\_fs\_imp, lmer(Amygdala ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_PLAY\_CortexVol <- with(dd\_b\_fs\_imp, lmer(CortexVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_PLAY\_SubCortGrayVol <- with(dd\_b\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_PLAY\_CerebralWhiteMatterVol <- with(dd\_b\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_PLAY\_Hippocampus <- with(dd\_b\_fs\_imp, lmer(Hippocampus ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_PLAY\_Amygdala <- with(dd\_b\_fs\_imp, lmer(Amygdala ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_TOTAL\_CortexVol <- with(dd\_b\_fs\_imp, lmer(CortexVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_TOTAL\_SubCortGrayVol <- with(dd\_b\_fs\_imp, lmer(SubCortGrayVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_b\_fs\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_TOTAL\_Hippocampus <- with(dd\_b\_fs\_imp, lmer(Hippocampus ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

M2PAboth\_fs\_TOTAL\_Amygdala <- with(dd\_b\_fs\_imp, lmer(Amygdala ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + bmichild9 + (1|IDC), dd\_b\_fs, REML = F))

all\_M2PAboth\_fs <- list(M2PAboth\_fs\_SPORT\_CortexVol = M2PAboth\_fs\_SPORT\_CortexVol,

M2PAboth\_fs\_SPORT\_SubCortGrayVol = M2PAboth\_fs\_SPORT\_SubCortGrayVol,

M2PAboth\_fs\_SPORT\_CerebralWhiteMatterVol = M2PAboth\_fs\_SPORT\_CerebralWhiteMatterVol,

M2PAboth\_fs\_SPORT\_Hippocampus = M2PAboth\_fs\_SPORT\_Hippocampus,

M2PAboth\_fs\_SPORT\_Amygdala = M2PAboth\_fs\_SPORT\_Amygdala,

M2PAboth\_fs\_PLAY\_CortexVol = M2PAboth\_fs\_PLAY\_CortexVol,

M2PAboth\_fs\_PLAY\_SubCortGrayVol = M2PAboth\_fs\_PLAY\_SubCortGrayVol,

M2PAboth\_fs\_PLAY\_CerebralWhiteMatterVol = M2PAboth\_fs\_PLAY\_CerebralWhiteMatterVol,

M2PAboth\_fs\_PLAY\_Hippocampus = M2PAboth\_fs\_PLAY\_Hippocampus,

M2PAboth\_fs\_PLAY\_Amygdala = M2PAboth\_fs\_PLAY\_Amygdala,

M2PAboth\_fs\_TOTAL\_CortexVol = M2PAboth\_fs\_TOTAL\_CortexVol,

M2PAboth\_fs\_TOTAL\_SubCortGrayVol = M2PAboth\_fs\_TOTAL\_SubCortGrayVol,

M2PAboth\_fs\_TOTAL\_CerebralWhiteMatterVol = M2PAboth\_fs\_TOTAL\_CerebralWhiteMatterVol,

M2PAboth\_fs\_TOTAL\_Hippocampus = M2PAboth\_fs\_TOTAL\_Hippocampus,

M2PAboth\_fs\_TOTAL\_Amygdala = M2PAboth\_fs\_TOTAL\_Amygdala)

out\_all\_M2PAboth\_fs <- lapply(all\_M2PAboth\_fs, function(x) summary(pool(x)))

out\_all\_M2PAboth\_fs

###############

# BOTH REPORTS: REPEATED BRAIN MEASURES SAMPLE (dd\_b\_cc) (n=1088)

###############

table(df$CortexVol\_t1 >= 0 & df$SubCortGrayVol\_t1 >= 0 & df$CerebralWhiteMatterVol\_t1 >= 0 &

df$Hippocampus\_t1 >= 0 & df$Amygdala\_t1 >= 0 &

df$CortexVol\_t2 >= 0 & df$SubCortGrayVol\_t2 >= 0 & df$CerebralWhiteMatterVol\_t2 >= 0 &

df$Hippocampus\_t2 >= 0 & df$Amygdala\_t2 >= 0) # (n=1088)

dd\_b\_cc <- subset(df, (df$CortexVol\_t1 >= 0 & df$SubCortGrayVol\_t1 >= 0 & df$CerebralWhiteMatterVol\_t1 >= 0 &

df$Hippocampus\_t1 >= 0 & df$Amygdala\_t1 >= 0 &

df$CortexVol\_t2 >= 0 & df$SubCortGrayVol\_t2 >= 0 & df$CerebralWhiteMatterVol\_t2 >= 0 &

df$Hippocampus\_t2 >= 0 & df$Amygdala\_t2 >= 0)) # (n=1088), correct!

dd\_b\_cc <- select(dd\_b\_cc, c("IDC", "CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1",

"Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2",

"Hippocampus\_t2", "Amygdala\_t2",

"PAbothSPORT", "PAbothPLAY", "PAbothTOTAL",

"age9", "GENDER", "edu", "ethn", "eTIV9", "bmichild9",

"season\_careg"))

# Check that all participants have at least one measure of physical activity (n=1088)

table(dd\_b\_cc$PAbothSPORT >= 0 | dd\_b\_cc$PAbothPLAY >= 0 | dd\_b\_cc$PAbothTOTAL >= 0) # (n=1088), correct!

## transform from wide format to long format

dd\_b\_cc <- dd\_b\_cc %>% pivot\_longer(

cols = c("CortexVol\_t1", "SubCortGrayVol\_t1", "CerebralWhiteMatterVol\_t1", "Hippocampus\_t1", "Amygdala\_t1",

"CortexVol\_t2", "SubCortGrayVol\_t2", "CerebralWhiteMatterVol\_t2", "Hippocampus\_t2", "Amygdala\_t2"),

names\_to = c(".value", "t"),

names\_sep = "\_")

dd\_b\_cc$t <- factor(dd\_b\_cc$t) # make t (time) a factor

dd\_b\_cc <- dd\_b\_cc[with(dd\_b\_cc, order(IDC, t)), ] # Order by IDC and time point, important for linear-mixed models

# Imputation

# set the imputation settings

predMat <- quickpred(dd\_b\_cc, exclude = c("IDC")) # prediction matrix

imp0 <- mice(dd\_b\_cc, maxit = 0) # dry run

meth <- imp0$method

# imputation with 30 iterations and 30 datasets

dd\_b\_cc\_imp <- mice(dd\_b\_cc, m=30, maxit = 30, predictorMatrix = predMat, method = meth, seed = 2022)

summary(dd\_b\_cc\_imp) # "pmm" for continuous and "polyreg" for categorical, correct!

## prueba, checking sample size is correct

dd\_b\_cc\_imp\_c3 <- complete(dd\_b\_cc\_imp, 3)

table(is.na(dd\_b\_cc\_imp\_c3$PAbothTOTAL)) # 2176 observations / 2 t = 1088 participants, correct!

############

# BOTH REPORTS: Analyses: repeated brain measures (n=1088)

############

# Model 1

M1PAboth\_cc\_SPORT\_CortexVol <- with(dd\_b\_cc\_imp, lmer(CortexVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_SPORT\_SubCortGrayVol <- with(dd\_b\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_SPORT\_CerebralWhiteMatterVol <- with(dd\_b\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_SPORT\_Hippocampus <- with(dd\_b\_cc\_imp, lmer(Hippocampus ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_SPORT\_Amygdala <- with(dd\_b\_cc\_imp, lmer(Amygdala ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_PLAY\_CortexVol <- with(dd\_b\_cc\_imp, lmer(CortexVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_PLAY\_SubCortGrayVol <- with(dd\_b\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_PLAY\_CerebralWhiteMatterVol <- with(dd\_b\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_PLAY\_Hippocampus <- with(dd\_b\_cc\_imp, lmer(Hippocampus ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_PLAY\_Amygdala <- with(dd\_b\_cc\_imp, lmer(Amygdala ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_TOTAL\_CortexVol <- with(dd\_b\_cc\_imp, lmer(CortexVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_TOTAL\_SubCortGrayVol <- with(dd\_b\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_b\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_TOTAL\_Hippocampus <- with(dd\_b\_cc\_imp, lmer(Hippocampus ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

M1PAboth\_cc\_TOTAL\_Amygdala <- with(dd\_b\_cc\_imp, lmer(Amygdala ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + (1|IDC), dd\_b\_cc, REML = F))

all\_M1PAboth\_cc <- list(M1PAboth\_cc\_SPORT\_CortexVol = M1PAboth\_cc\_SPORT\_CortexVol,

M1PAboth\_cc\_SPORT\_SubCortGrayVol = M1PAboth\_cc\_SPORT\_SubCortGrayVol,

M1PAboth\_cc\_SPORT\_CerebralWhiteMatterVol = M1PAboth\_cc\_SPORT\_CerebralWhiteMatterVol,

M1PAboth\_cc\_SPORT\_Hippocampus = M1PAboth\_cc\_SPORT\_Hippocampus,

M1PAboth\_cc\_SPORT\_Amygdala = M1PAboth\_cc\_SPORT\_Amygdala,

M1PAboth\_cc\_PLAY\_CortexVol = M1PAboth\_cc\_PLAY\_CortexVol,

M1PAboth\_cc\_PLAY\_SubCortGrayVol = M1PAboth\_cc\_PLAY\_SubCortGrayVol,

M1PAboth\_cc\_PLAY\_CerebralWhiteMatterVol = M1PAboth\_cc\_PLAY\_CerebralWhiteMatterVol,

M1PAboth\_cc\_PLAY\_Hippocampus = M1PAboth\_cc\_PLAY\_Hippocampus,

M1PAboth\_cc\_PLAY\_Amygdala = M1PAboth\_cc\_PLAY\_Amygdala,

M1PAboth\_cc\_TOTAL\_CortexVol = M1PAboth\_cc\_TOTAL\_CortexVol,

M1PAboth\_cc\_TOTAL\_SubCortGrayVol = M1PAboth\_cc\_TOTAL\_SubCortGrayVol,

M1PAboth\_cc\_TOTAL\_CerebralWhiteMatterVol = M1PAboth\_cc\_TOTAL\_CerebralWhiteMatterVol,

M1PAboth\_cc\_TOTAL\_Hippocampus = M1PAboth\_cc\_TOTAL\_Hippocampus,

M1PAboth\_cc\_TOTAL\_Amygdala = M1PAboth\_cc\_TOTAL\_Amygdala)

out\_all\_M1PAboth\_cc <- lapply(all\_M1PAboth\_cc, function(x) summary(pool(x)))

out\_all\_M1PAboth\_cc

# Model 2

M2PAboth\_cc\_SPORT\_CortexVol <- with(dd\_b\_cc\_imp, lmer(CortexVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_SPORT\_SubCortGrayVol <- with(dd\_b\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_SPORT\_CerebralWhiteMatterVol <- with(dd\_b\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_SPORT\_Hippocampus <- with(dd\_b\_cc\_imp, lmer(Hippocampus ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_SPORT\_Amygdala <- with(dd\_b\_cc\_imp, lmer(Amygdala ~ t\*PAbothSPORT + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_PLAY\_CortexVol <- with(dd\_b\_cc\_imp, lmer(CortexVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_PLAY\_SubCortGrayVol <- with(dd\_b\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_PLAY\_CerebralWhiteMatterVol <- with(dd\_b\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_PLAY\_Hippocampus <- with(dd\_b\_cc\_imp, lmer(Hippocampus ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_PLAY\_Amygdala <- with(dd\_b\_cc\_imp, lmer(Amygdala ~ t\*PAbothPLAY + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_TOTAL\_CortexVol <- with(dd\_b\_cc\_imp, lmer(CortexVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_TOTAL\_SubCortGrayVol <- with(dd\_b\_cc\_imp, lmer(SubCortGrayVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_TOTAL\_CerebralWhiteMatterVol <- with(dd\_b\_cc\_imp, lmer(CerebralWhiteMatterVol ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_TOTAL\_Hippocampus <- with(dd\_b\_cc\_imp, lmer(Hippocampus ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

M2PAboth\_cc\_TOTAL\_Amygdala <- with(dd\_b\_cc\_imp, lmer(Amygdala ~ t\*PAbothTOTAL + age9 + GENDER + edu + ethn + eTIV9 + season\_careg + bmichild9 + (1|IDC), dd\_b\_cc, REML = F))

all\_M2PAboth\_cc <- list(M2PAboth\_cc\_SPORT\_CortexVol = M2PAboth\_cc\_SPORT\_CortexVol,

M2PAboth\_cc\_SPORT\_SubCortGrayVol = M2PAboth\_cc\_SPORT\_SubCortGrayVol,

M2PAboth\_cc\_SPORT\_CerebralWhiteMatterVol = M2PAboth\_cc\_SPORT\_CerebralWhiteMatterVol,

M2PAboth\_cc\_SPORT\_Hippocampus = M2PAboth\_cc\_SPORT\_Hippocampus,

M2PAboth\_cc\_SPORT\_Amygdala = M2PAboth\_cc\_SPORT\_Amygdala,

M2PAboth\_cc\_PLAY\_CortexVol = M2PAboth\_cc\_PLAY\_CortexVol,

M2PAboth\_cc\_PLAY\_SubCortGrayVol = M2PAboth\_cc\_PLAY\_SubCortGrayVol,

M2PAboth\_cc\_PLAY\_CerebralWhiteMatterVol = M2PAboth\_cc\_PLAY\_CerebralWhiteMatterVol,

M2PAboth\_cc\_PLAY\_Hippocampus = M2PAboth\_cc\_PLAY\_Hippocampus,

M2PAboth\_cc\_PLAY\_Amygdala = M2PAboth\_cc\_PLAY\_Amygdala,

M2PAboth\_cc\_TOTAL\_CortexVol = M2PAboth\_cc\_TOTAL\_CortexVol,

M2PAboth\_cc\_TOTAL\_SubCortGrayVol = M2PAboth\_cc\_TOTAL\_SubCortGrayVol,

M2PAboth\_cc\_TOTAL\_CerebralWhiteMatterVol = M2PAboth\_cc\_TOTAL\_CerebralWhiteMatterVol,

M2PAboth\_cc\_TOTAL\_Hippocampus = M2PAboth\_cc\_TOTAL\_Hippocampus,

M2PAboth\_cc\_TOTAL\_Amygdala = M2PAboth\_cc\_TOTAL\_Amygdala)

out\_all\_M2PAboth\_cc <- lapply(all\_M2PAboth\_cc, function(x) summary(pool(x)))

out\_all\_M2PAboth\_cc

###################################################################################

################### Save outputs of linear-mixed models ###########################

###################################################################################

sink('out\_all\_M1PAchild\_fs.txt')

print(out\_all\_M1PAchild\_fs)

sink()

sink('out\_all\_M2PAchild\_fs.txt')

print(out\_all\_M2PAchild\_fs)

sink()

sink('out\_all\_M1PAchild\_cc.txt')

print(out\_all\_M1PAchild\_cc)

sink()

sink('out\_all\_M2PAchild\_cc.txt')

print(out\_all\_M2PAchild\_cc)

sink()

sink('out\_all\_M1PAparent\_fs.txt')

print(out\_all\_M1PAparent\_fs)

sink()

sink('out\_all\_M2PAparent\_fs.txt')

print(out\_all\_M2PAparent\_fs)

sink()

sink('out\_all\_M1PAparent\_cc.txt')

print(out\_all\_M1PAparent\_cc)

sink()

sink('out\_all\_M2PAparent\_cc.txt')

print(out\_all\_M2PAparent\_cc)

sink()

sink('out\_all\_M1PAboth\_fs.txt')

print(out\_all\_M1PAboth\_fs)

sink()

sink('out\_all\_M2PAboth\_fs.txt')

print(out\_all\_M2PAboth\_fs)

sink()

sink('out\_all\_M1PAboth\_cc.txt')

print(out\_all\_M1PAboth\_cc)

sink()

sink('out\_all\_M2PAboth\_cc.txt')

print(out\_all\_M2PAboth\_cc)

sink()