Chapter 4 Analyses and Output

#######################################################################################  
# Chapter 4 Data Analyses  
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#######################################################################################  
  
  
#Data management---------------------------------------------  
if (!require("pacman")) install.packages("pacman")

## Loading required package: pacman

## Warning: package 'pacman' was built under R version 3.5.3

pacman::p\_load(readxl, dplyr, psych, Hmisc,lavaan, semPlot, semTools, ppcor, pastecs)  
setwd("C:/Users/rfalck/Desktop/UBC-PhD/Thesis Material/Thesis defense materials/Theis Data and Analyses")#Directory where you put the spreadsheet  
PAS <- read\_excel("Chapter 4 Data.xlsx", sheet= "Final Data Set")  
  
PA\_Sleep <- subset(PAS, Complete.data.13days =='1')  
  
spaceless <- function(x) {colnames(x) <- gsub(" ", "\_", colnames(x));x}  
PA\_Sleep <- spaceless(PA\_Sleep)  
  
#Daily averages  
PA\_Sleep$Avg.Frag <- (PA\_Sleep$Fragmentation.Day.1 + PA\_Sleep$Fragmentation.Day.2 + PA\_Sleep$Fragmentation.Day.3 + PA\_Sleep$Fragmentation.Day.4 + PA\_Sleep$Fragmentation.Day.5 + PA\_Sleep$Fragmentation.Day.6 + PA\_Sleep$Fragmentation.Day.7 + PA\_Sleep$Fragmentation.Day.8 + PA\_Sleep$Fragmentation.Day.9 + PA\_Sleep$Fragmentation.Day.10 + PA\_Sleep$Fragmentation.Day.11 + PA\_Sleep$Fragmentation.Day.12 + PA\_Sleep$Fragmentation.Day.13)/13  
PA\_Sleep$Avg.Dur <- (PA\_Sleep$Duration.Day.1 + PA\_Sleep$Duration.Day.2 + PA\_Sleep$Duration.Day.3 + PA\_Sleep$Duration.Day.4 + PA\_Sleep$Duration.Day.5 + PA\_Sleep$Duration.Day.6 + PA\_Sleep$Duration.Day.7 + PA\_Sleep$Duration.Day.8 + PA\_Sleep$Duration.Day.9 + PA\_Sleep$Duration.Day.10 + PA\_Sleep$Duration.Day.11 + PA\_Sleep$Duration.Day.12 + PA\_Sleep$Duration.Day.13)/13  
PA\_Sleep$Avg.Lat <- (PA\_Sleep$Latency.Day.1 +PA\_Sleep$Latency.Day.2 + PA\_Sleep$Latency.Day.3 + PA\_Sleep$Latency.Day.4 + PA\_Sleep$Latency.Day.5 + PA\_Sleep$Latency.Day.6 + PA\_Sleep$Latency.Day.7 + PA\_Sleep$Latency.Day.8 + PA\_Sleep$Latency.Day.9 + PA\_Sleep$Latency.Day.10 + PA\_Sleep$Latency.Day.11 + PA\_Sleep$Latency.Day.12 + PA\_Sleep$Latency.Day.13)/13  
PA\_Sleep$Avg.Eff <- (PA\_Sleep$Efficiency.Day.1 + PA\_Sleep$Efficiency.Day.2 + PA\_Sleep$Efficiency.Day.3 + PA\_Sleep$Efficiency.Day.4 + PA\_Sleep$Efficiency.Day.5 + PA\_Sleep$Efficiency.Day.6 + PA\_Sleep$Efficiency.Day.7 + PA\_Sleep$Efficiency.Day.8 + PA\_Sleep$Efficiency.Day.9 + PA\_Sleep$Efficiency.Day.10 + PA\_Sleep$Efficiency.Day.11 + PA\_Sleep$Efficiency.Day.12 + PA\_Sleep$Efficiency.Day.13)/13  
PA\_Sleep$Avg.PA <- (PA\_Sleep$MVPA.Minutes.Day.1 + PA\_Sleep$MVPA.Minutes.Day.2 + PA\_Sleep$MVPA.Minutes.Day.3 + PA\_Sleep$MVPA.Minutes.Day.4 + PA\_Sleep$MVPA.Minutes.Day.5 + PA\_Sleep$MVPA.Minutes.Day.6 + PA\_Sleep$MVPA.Minutes.Day.7 + PA\_Sleep$MVPA.Minutes.Day.8 + PA\_Sleep$MVPA.Minutes.Day.9 + PA\_Sleep$MVPA.Minutes.Day.10 + PA\_Sleep$MVPA.Minutes.Day.11 + PA\_Sleep$MVPA.Minutes.Day.12 + PA\_Sleep$MVPA.Minutes.Day.13)/13  
PA\_Sleep$Avg.Awake <- (PA\_Sleep$Awakenings.1 + PA\_Sleep$Awakenings.2 + PA\_Sleep$Awakenings.3 + PA\_Sleep$Awakenings.4 + PA\_Sleep$Awakenings.5 + PA\_Sleep$Awakenings.6 + PA\_Sleep$Awakenings.7 + PA\_Sleep$Awakenings.8 + PA\_Sleep$Awakenings.9 + PA\_Sleep$Awakenings.10 + PA\_Sleep$Awakenings.11 + PA\_Sleep$Awakenings.12 + PA\_Sleep$Awakenings.13)/13  
  
PA\_Sleep$Smoking<-NA  
PA\_Sleep$Smoking[PA\_Sleep$Current.Smoker=="1"]<-2  
PA\_Sleep$Smoking[PA\_Sleep$Past.Smoker=="1"]<-1  
PA\_Sleep$Smoking[PA\_Sleep$Past.Smoker=="0"]<-0  
  
PA\_Sleep<-rename(PA\_Sleep, "ADAS.Cog.Plus"="ADAS-Cog\_Plus")  
  
#Removing outliers  
PA\_Sleep.1 <- PA\_Sleep[ which(PA\_Sleep$Avg.Pcnt.MVPA < 29.97 & PA\_Sleep$Avg.Frag < 64.58 & PA\_Sleep$Avg.Lat < 34.17 & PA\_Sleep$Avg.Eff > 64.13 & PA\_Sleep$ADAS.Cog.Plus < 1.29),]  
  
  
#Descriptive statistics for full data set-------------------------------  
describe(PA\_Sleep$Age)

## PA\_Sleep$Age   
## n missing distinct Info Mean Gmd .05 .10   
## 146 0 29 0.997 71.25 8.067 58.00 62.00   
## .25 .50 .75 .90 .95   
## 67.00 73.00 76.00 80.00 80.75   
##   
## lowest : 53 55 56 57 58, highest: 80 81 83 85 101

sd(PA\_Sleep$Age)

## [1] 7.261435

Sex.table <- table(PA\_Sleep$Sex)  
cbind(Sex.table,prop.table(Sex.table))

## Sex.table   
## 0 97 0.6643836  
## 1 49 0.3356164

Smoking.table <- table(PA\_Sleep$Smoking)  
cbind(Smoking.table,prop.table(Smoking.table))

## Smoking.table   
## 0 72 0.49315068  
## 1 72 0.49315068  
## 2 2 0.01369863

Education.table <- table(PA\_Sleep$Education)  
cbind(Education.table,prop.table(Education.table))

## Education.table   
## 0 2 0.01369863  
## 1 5 0.03424658  
## 2 19 0.13013699  
## 3 17 0.11643836  
## 4 24 0.16438356  
## 5 79 0.54109589

describe(PA\_Sleep$MMSE)

## PA\_Sleep$MMSE   
## n missing distinct Info Mean Gmd   
## 146 0 6 0.904 28.9 1.154   
##   
## Value 25 26 27 28 29 30  
## Frequency 2 2 13 25 54 50  
## Proportion 0.014 0.014 0.089 0.171 0.370 0.342

sd(PA\_Sleep$MMSE)

## [1] 1.100028

describe(PA\_Sleep$MoCA)

## PA\_Sleep$MoCA   
## n missing distinct Info Mean Gmd .05 .10   
## 146 0 15 0.987 24.79 3.16 20 21   
## .25 .50 .75 .90 .95   
## 23 25 27 28 29   
##   
## Value 14 17 18 19 20 21 22 23 24 25  
## Frequency 1 2 1 2 5 6 13 14 15 21  
## Proportion 0.007 0.014 0.007 0.014 0.034 0.041 0.089 0.096 0.103 0.144  
##   
## Value 26 27 28 29 30  
## Frequency 22 18 16 9 1  
## Proportion 0.151 0.123 0.110 0.062 0.007

sd(PA\_Sleep$MoCA)

## [1] 2.852507

describe(PA\_Sleep$ADAS.Cog.Plus)

## PA\_Sleep$ADAS.Cog.Plus   
## n missing distinct Info Mean Gmd .05 .10   
## 146 0 146 1 -0.7763 0.7775 -1.85427 -1.58644   
## .25 .50 .75 .90 .95   
## -1.26629 -0.84971 -0.24178 0.09754 0.33827   
##   
## lowest : -2.3294031 -2.1011506 -2.0725233 -2.0035884 -1.9628815  
## highest: 0.5351734 0.5704684 0.6078686 0.9538560 1.5182212

sd(PA\_Sleep$ADAS.Cog.Plus)

## [1] 0.6866147

describe(PA\_Sleep$Avg.Pcnt.MVPA)

## PA\_Sleep$Avg.Pcnt.MVPA   
## n missing distinct Info Mean Gmd .05 .10   
## 146 0 146 1 10.29 7.012 2.748 3.392   
## .25 .50 .75 .90 .95   
## 5.682 8.470 13.977 17.581 21.031   
##   
## lowest : 0.2096788 0.5814788 0.9228467 2.3703815 2.4066064  
## highest: 28.0677581 28.2473735 29.2015328 32.2167799 38.6085018

sd(PA\_Sleep$Avg.Pcnt.MVPA)

## [1] 6.564083

##Adjusted values for Fragmentation, Efficiency, and Duration##  
PA\_Sleep$Frag.fit <- NA  
Frag\_lm <- lm(Avg.Frag ~ Avg.Awake, data=PA\_Sleep, na.action = na.exclude)  
PA\_Sleep$Frag.fit <- fitted(Frag\_lm)  
  
PA\_Sleep$Eff.fit <- NA  
Eff\_lm <- lm(Avg.Eff ~ Avg.Awake, data=PA\_Sleep, na.action = na.exclude)  
PA\_Sleep$Eff.fit <- fitted(Eff\_lm)  
  
PA\_Sleep$Lat.fit <- NA  
Lat\_lm <- lm(Avg.Lat ~ Avg.Awake, data=PA\_Sleep, na.action = na.exclude)  
PA\_Sleep$Lat.fit <- fitted(Lat\_lm)  
  
  
#descriptives for fitted variables#  
  
stat.desc(PA\_Sleep$Frag.fit)

## nbr.val nbr.null nbr.na min max   
## 145.0000000 0.0000000 1.0000000 16.1831820 54.1466373   
## range sum median mean SE.mean   
## 37.9634553 4535.7615385 30.7190875 31.2811141 0.6143255   
## CI.mean.0.95 var std.dev coef.var   
## 1.2142604 54.7223906 7.3974584 0.2364832

sd(PA\_Sleep$Frag.fit)

## [1] NA

stat.desc(PA\_Sleep$Eff.fit)

## nbr.val nbr.null nbr.na min max   
## 1.450000e+02 0.000000e+00 1.000000e+00 7.012686e+01 9.070838e+01   
## range sum median mean SE.mean   
## 2.058152e+01 1.196586e+04 8.282788e+01 8.252318e+01 3.330507e-01   
## CI.mean.0.95 var std.dev coef.var   
## 6.582997e-01 1.608380e+01 4.010461e+00 4.859800e-02

sd(PA\_Sleep$Eff.fit)

## [1] NA

describe(PA\_Sleep$Avg.Dur)

## PA\_Sleep$Avg.Dur   
## n missing distinct Info Mean Gmd .05 .10   
## 146 0 141 1 401.5 53.29 326.9 340.8   
## .25 .50 .75 .90 .95   
## 369.8 398.3 433.1 463.1 486.9   
##   
## lowest : 294.2308 307.0000 309.4615 318.3846 323.6923  
## highest: 495.6154 498.9231 506.5385 510.6923 541.7692

sd(PA\_Sleep$Avg.Dur)

## [1] 47.09774

stat.desc(PA\_Sleep$Lat.fit)

## nbr.val nbr.null nbr.na min max   
## 146.0000000 0.0000000 0.0000000 2.5820237 13.2420788   
## range sum median mean SE.mean   
## 10.6600551 994.8461538 6.6311078 6.8140148 0.1714787   
## CI.mean.0.95 var std.dev coef.var   
## 0.3389207 4.2931205 2.0719847 0.3040769

sd(PA\_Sleep$Lat.fit)

## [1] 2.071985

#Descriptive statistics for outliers removed data set  
  
describe(PA\_Sleep.1$Age)

## PA\_Sleep.1$Age   
## n missing distinct Info Mean Gmd .05 .10   
## 137 0 29 0.997 71.22 7.994 57.8 62.0   
## .25 .50 .75 .90 .95   
## 67.0 73.0 76.0 80.0 80.0   
##   
## lowest : 53 55 56 57 58, highest: 80 81 83 85 101

sd(PA\_Sleep.1$Age)

## [1] 7.232194

Sex.table <- table(PA\_Sleep.1$Sex)  
cbind(Sex.table,prop.table(Sex.table))

## Sex.table   
## 0 93 0.6788321  
## 1 44 0.3211679

Smoking.table <- table(PA\_Sleep.1$Smoking)  
cbind(Smoking.table,prop.table(Smoking.table))

## Smoking.table   
## 0 69 0.50364964  
## 1 66 0.48175182  
## 2 2 0.01459854

Education.table <- table(PA\_Sleep.1$Education)  
cbind(Education.table,prop.table(Education.table))

## Education.table   
## 0 1 0.00729927  
## 1 5 0.03649635  
## 2 19 0.13868613  
## 3 15 0.10948905  
## 4 23 0.16788321  
## 5 74 0.54014599

describe(PA\_Sleep.1$MMSE)

## PA\_Sleep.1$MMSE   
## n missing distinct Info Mean Gmd   
## 137 0 6 0.899 28.94 1.086   
##   
## Value 25 26 27 28 29 30  
## Frequency 1 1 12 24 52 47  
## Proportion 0.007 0.007 0.088 0.175 0.380 0.343

sd(PA\_Sleep.1$MMSE)

## [1] 1.027321

describe(PA\_Sleep.1$MoCA)

## PA\_Sleep.1$MoCA   
## n missing distinct Info Mean Gmd .05 .10   
## 137 0 14 0.987 24.88 3.056 20 21   
## .25 .50 .75 .90 .95   
## 23 25 27 28 29   
##   
## Value 14 18 19 20 21 22 23 24 25 26  
## Frequency 1 1 2 5 6 12 14 13 21 20  
## Proportion 0.007 0.007 0.015 0.036 0.044 0.088 0.102 0.095 0.153 0.146  
##   
## Value 27 28 29 30  
## Frequency 18 14 9 1  
## Proportion 0.131 0.102 0.066 0.007

sd(PA\_Sleep.1$MoCA)

## [1] 2.74517

describe(PA\_Sleep.1$ADAS.Cog.Plus)

## PA\_Sleep.1$ADAS.Cog.Plus   
## n missing distinct Info Mean Gmd .05 .10   
## 137 0 137 1 -0.7696 0.7414 -1.84339 -1.57623   
## .25 .50 .75 .90 .95   
## -1.21020 -0.83374 -0.24640 0.09412 0.25200   
##   
## lowest : -2.3294031 -2.1011506 -2.0725233 -2.0035884 -1.9628815  
## highest: 0.4840872 0.5351734 0.5704684 0.6078686 0.9538560

sd(PA\_Sleep.1$ADAS.Cog.Plus)

## [1] 0.6507327

describe(PA\_Sleep.1$Avg.Pcnt.MVPA)

## PA\_Sleep.1$Avg.Pcnt.MVPA   
## n missing distinct Info Mean Gmd .05 .10   
## 137 0 137 1 9.914 6.418 2.792 3.393   
## .25 .50 .75 .90 .95   
## 5.750 8.349 13.386 17.136 18.919   
##   
## lowest : 0.2096788 0.5814788 0.9228467 2.3703815 2.5889185  
## highest: 22.4264706 27.3134700 28.0677581 28.2473735 29.2015328

sd(PA\_Sleep.1$Avg.Pcnt.MVPA)

## [1] 5.83748

##Adjusted values for Fragmentation, Efficiency, and Duration##  
PA\_Sleep.1$Frag.fit <- NA  
Frag\_lm <- lm(Avg.Frag ~ Avg.Awake, data=PA\_Sleep.1, na.action = na.exclude)  
PA\_Sleep.1$Frag.fit <- fitted(Frag\_lm)  
  
PA\_Sleep.1$Eff.fit <- NA  
Eff\_lm <- lm(Avg.Eff ~ Avg.Awake, data=PA\_Sleep.1, na.action = na.exclude)  
PA\_Sleep.1$Eff.fit <- fitted(Eff\_lm)  
  
PA\_Sleep.1$Lat.fit <- NA  
Lat\_lm <- lm(Avg.Lat ~ Avg.Awake, data=PA\_Sleep.1, na.action = na.exclude)  
PA\_Sleep.1$Lat.fit <- fitted(Lat\_lm)  
  
#Averages for fitted variables  
stat.desc(PA\_Sleep.1$Frag.fit)

## nbr.val nbr.null nbr.na min max   
## 137.0000000 0.0000000 0.0000000 18.0277520 46.9669364   
## range sum median mean SE.mean   
## 28.9391844 4160.6307692 29.9936170 30.3695677 0.4798621   
## CI.mean.0.95 var std.dev coef.var   
## 0.9489565 31.5466658 5.6166419 0.1849431

sd(PA\_Sleep.1$Frag.fit)

## [1] 5.616642

stat.desc(PA\_Sleep.1$Eff.fit)

## nbr.val nbr.null nbr.na min max   
## 1.370000e+02 0.000000e+00 0.000000e+00 7.363977e+01 9.013453e+01   
## range sum median mean SE.mean   
## 1.649476e+01 1.138469e+04 8.331423e+01 8.309994e+01 2.735119e-01   
## CI.mean.0.95 var std.dev coef.var   
## 5.408864e-01 1.024880e+01 3.201375e+00 3.852439e-02

sd(PA\_Sleep.1$Eff.fit)

## [1] 3.201375

describe(PA\_Sleep.1$Avg.Dur)

## PA\_Sleep.1$Avg.Dur   
## n missing distinct Info Mean Gmd .05 .10   
## 137 0 133 1 402.4 53.14 326.0 340.0   
## .25 .50 .75 .90 .95   
## 371.4 399.2 434.5 462.8 486.0   
##   
## lowest : 294.2308 307.0000 309.4615 318.3846 323.6923  
## highest: 493.3846 495.6154 498.9231 510.6923 541.7692

sd(PA\_Sleep.1$Avg.Dur)

## [1] 46.90479

stat.desc(PA\_Sleep.1$Lat.fit)

## nbr.val nbr.null nbr.na min max   
## 137.00000000 0.00000000 0.00000000 3.66483909 8.44124472   
## range sum median mean SE.mean   
## 4.77640562 781.15384615 5.63980232 5.70185289 0.07920113   
## CI.mean.0.95 var std.dev coef.var   
## 0.15662504 0.85937614 0.92702543 0.16258319

sd(PA\_Sleep.1$Lat.fit)

## [1] 0.9270254

#Correlations for full data set------------------------------------------  
Correlation.Full <- subset(PA\_Sleep, select=c(Age, PSQI.Total, ADAS.Cog.Plus, Avg.Pcnt.MVPA, Avg.Frag, Avg.Eff, Avg.Dur, Avg.Lat, Avg.Awake))  
Correlation.Full <-subset(Correlation.Full, Avg.Frag !='NA' & Avg.Eff !='NA' & Avg.Awake !='NA' & Avg.Dur != 'NA' & Avg.Lat !='NA' & Avg.Pcnt.MVPA != 'NA')  
Correlation.Full.PSQI <- subset(Correlation.Full, PSQI.Total !='NA')  
cor(Correlation.Full, use= "complete.obs")

## Age PSQI.Total ADAS.Cog.Plus Avg.Pcnt.MVPA  
## Age 1.0000000000 -0.094281067 0.376371172 -0.313349502  
## PSQI.Total -0.0942810674 1.000000000 0.008619298 0.008229139  
## ADAS.Cog.Plus 0.3763711724 0.008619298 1.000000000 -0.285157687  
## Avg.Pcnt.MVPA -0.3133495017 0.008229139 -0.285157687 1.000000000  
## Avg.Frag 0.2419394082 -0.046156971 -0.035340063 -0.068983031  
## Avg.Eff -0.0551897942 -0.007177664 0.184972656 -0.141752628  
## Avg.Dur 0.1995211355 0.032135252 0.217901183 -0.026198509  
## Avg.Lat 0.0008457997 0.180361348 0.001495509 -0.064540414  
## Avg.Awake 0.0046327405 -0.075469853 -0.019682149 0.112431937  
## Avg.Frag Avg.Eff Avg.Dur Avg.Lat  
## Age 0.24193941 -0.055189794 0.19952114 0.0008457997  
## PSQI.Total -0.04615697 -0.007177664 0.03213525 0.1803613482  
## ADAS.Cog.Plus -0.03534006 0.184972656 0.21790118 0.0014955087  
## Avg.Pcnt.MVPA -0.06898303 -0.141752628 -0.02619851 -0.0645404135  
## Avg.Frag 1.00000000 -0.776792856 -0.32800535 0.3277156821  
## Avg.Eff -0.77679286 1.000000000 0.52566556 -0.4991314133  
## Avg.Dur -0.32800535 0.525665564 1.00000000 -0.1719134197  
## Avg.Lat 0.32771568 -0.499131413 -0.17191342 1.0000000000  
## Avg.Awake 0.67051772 -0.656886329 -0.11438768 0.2247026164  
## Avg.Awake  
## Age 0.00463274  
## PSQI.Total -0.07546985  
## ADAS.Cog.Plus -0.01968215  
## Avg.Pcnt.MVPA 0.11243194  
## Avg.Frag 0.67051772  
## Avg.Eff -0.65688633  
## Avg.Dur -0.11438768  
## Avg.Lat 0.22470262  
## Avg.Awake 1.00000000

cor.test(Correlation.Full$Avg.Dur, Correlation.Full$Avg.Pcnt.MVPA)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full$Avg.Dur and Correlation.Full$Avg.Pcnt.MVPA  
## t = -0.36977, df = 143, p-value = 0.7121  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1929443 0.1327710  
## sample estimates:  
## cor   
## -0.03090712

#Correlations for Full Dataset accounting for Awakenings#  
  
cor.test(Correlation.Full.PSQI$PSQI.Total, Correlation.Full.PSQI$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full.PSQI$PSQI.Total and Correlation.Full.PSQI$Age  
## t = -1.1285, df = 142, p-value = 0.261  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.25394069 0.07038027  
## sample estimates:  
## cor   
## -0.09428107

cor.test(Correlation.Full$ADAS.Cog.Plus, Correlation.Full$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full$ADAS.Cog.Plus and Correlation.Full$Age  
## t = 4.9118, df = 143, p-value = 2.435e-06  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## 0.2312567 0.5112863  
## sample estimates:  
## cor   
## 0.3799432

cor.test(Correlation.Full$Avg.Pcnt.MVPA, Correlation.Full$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full$Avg.Pcnt.MVPA and Correlation.Full$Age  
## t = -3.8505, df = 143, p-value = 0.0001772  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.4471681 -0.1510374  
## sample estimates:  
## cor   
## -0.3065004

pcor.test(Correlation.Full$Avg.Frag, Correlation.Full$Age, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.3301162 5.328256e-05 4.167412 145 1 pearson

pcor.test(Correlation.Full$Avg.Eff, Correlation.Full$Age, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.0769421 0.3593429 -0.9195971 145 1 pearson

cor.test(Correlation.Full$Avg.Dur, Correlation.Full$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full$Avg.Dur and Correlation.Full$Age  
## t = 2.2522, df = 143, p-value = 0.02583  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## 0.02276083 0.33789811  
## sample estimates:  
## cor   
## 0.1850834

pcor.test(Correlation.Full$Avg.Lat, Correlation.Full$Age, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.001942764 0.9815625 -0.02315075 145 1 pearson

cor.test(Correlation.Full.PSQI$ADAS.Cog.Plus, Correlation.Full.PSQI$PSQI.Total)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full.PSQI$ADAS.Cog.Plus and Correlation.Full.PSQI$PSQI.Total  
## t = 0.10271, df = 142, p-value = 0.9183  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1551754 0.1719528  
## sample estimates:  
## cor   
## 0.008619298

cor.test(Correlation.Full.PSQI$Avg.Pcnt.MVPA, Correlation.Full.PSQI$PSQI.Total)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full.PSQI$Avg.Pcnt.MVPA and Correlation.Full.PSQI$PSQI.Total  
## t = 0.098065, df = 142, p-value = 0.922  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1555562 0.1715741  
## sample estimates:  
## cor   
## 0.008229139

pcor.test(Correlation.Full.PSQI$Avg.Frag, Correlation.Full.PSQI$PSQI.Total, Correlation.Full.PSQI$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.006011134 0.9431968 0.07137956 144 1 pearson

pcor.test(Correlation.Full.PSQI$Avg.Eff, Correlation.Full.PSQI$PSQI.Total, Correlation.Full.PSQI$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.07548525 0.3702372 -0.8989023 144 1 pearson

cor.test(Correlation.Full.PSQI$Avg.Dur, Correlation.Full.PSQI$PSQI.Total)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full.PSQI$Avg.Dur and Correlation.Full.PSQI$PSQI.Total  
## t = 0.38313, df = 142, p-value = 0.7022  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1321353 0.1946878  
## sample estimates:  
## cor   
## 0.03213525

pcor.test(Correlation.Full.PSQI$Avg.Lat, Correlation.Full.PSQI$PSQI.Total, Correlation.Full.PSQI$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.2030772 0.01499336 2.462724 144 1 pearson

cor.test(Correlation.Full$Avg.Pcnt.MVPA, Correlation.Full$ADAS.Cog.Plus)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full$Avg.Pcnt.MVPA and Correlation.Full$ADAS.Cog.Plus  
## t = -3.5116, df = 143, p-value = 0.0005963  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.4252373 -0.1244663  
## sample estimates:  
## cor   
## -0.2817589

pcor.test(Correlation.Full$Avg.Frag, Correlation.Full$ADAS.Cog.Plus, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.0230419 0.7839852 -0.2746489 145 1 pearson

pcor.test(Correlation.Full$Avg.Eff, Correlation.Full$ADAS.Cog.Plus, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.2225733 0.007333185 2.720509 145 1 pearson

cor.test(Correlation.Full$Avg.Dur, Correlation.Full$ADAS.Cog.Plus)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full$Avg.Dur and Correlation.Full$ADAS.Cog.Plus  
## t = 2.5619, df = 143, p-value = 0.01144  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## 0.04812071 0.36019587  
## sample estimates:  
## cor   
## 0.2094867

pcor.test(Correlation.Full$Avg.Lat, Correlation.Full$ADAS.Cog.Plus, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.005114954 0.9514827 0.0609525 145 1 pearson

pcor.test(Correlation.Full$Avg.Frag, Correlation.Full$Avg.Pcnt.MVPA, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.1888147 0.0234235 -2.291199 145 1 pearson

pcor.test(Correlation.Full$Avg.Eff, Correlation.Full$Avg.Pcnt.MVPA, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.09409719 0.2619406 -1.126295 145 1 pearson

cor.test(Correlation.Full$Avg.Dur, Correlation.Full$Avg.Pcnt.MVPA)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.Full$Avg.Dur and Correlation.Full$Avg.Pcnt.MVPA  
## t = -0.36977, df = 143, p-value = 0.7121  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1929443 0.1327710  
## sample estimates:  
## cor   
## -0.03090712

pcor.test(Correlation.Full$Avg.Lat, Correlation.Full$Avg.Pcnt.MVPA, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.09342433 0.2653826 -1.11817 145 1 pearson

pcor.test(Correlation.Full$Avg.Eff, Correlation.Full$Avg.Frag, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.6043916 1.05077e-15 -9.040129 145 1 pearson

pcor.test(Correlation.Full$Avg.Dur, Correlation.Full$Avg.Frag, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.3496639 1.740648e-05 -4.447472 145 1 pearson

pcor.test(Correlation.Full$Avg.Lat, Correlation.Full$Avg.Frag, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.2415229 0.0035419 2.965882 145 1 pearson

pcor.test(Correlation.Full$Avg.Dur, Correlation.Full$Avg.Eff, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.6046381 1.015902e-15 9.045942 145 1 pearson

pcor.test(Correlation.Full$Avg.Lat, Correlation.Full$Avg.Eff, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.4756873 1.68832e-09 -6.444265 145 1 pearson

pcor.test(Correlation.Full$Avg.Dur, Correlation.Full$Avg.Lat, Correlation.Full$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.1480635 0.07655208 -1.784044 145 1 pearson

#Correlations for outliers removed data set------------------------------------  
Correlation <- subset(PA\_Sleep.1, select=c(Age, PSQI.Total, ADAS.Cog.Plus, Avg.Pcnt.MVPA, Avg.Frag, Avg.Eff, Avg.Dur, Avg.Lat, Avg.Awake))  
Correlation <-subset(Correlation, Avg.Frag !='NA' & Avg.Eff !='NA' & Avg.Awake !='NA' & Avg.Dur != 'NA' & Avg.Lat !='NA' & Avg.Pcnt.MVPA != 'NA')  
Correlation.PSQI <- subset(Correlation, PSQI.Total !='NA')  
cor(Correlation, use= "complete.obs")

## Age PSQI.Total ADAS.Cog.Plus Avg.Pcnt.MVPA  
## Age 1.000000000 -0.08142039 0.36036627 -0.316432232  
## PSQI.Total -0.081420393 1.00000000 0.04866775 0.068252798  
## ADAS.Cog.Plus 0.360366272 0.04866775 1.00000000 -0.287666457  
## Avg.Pcnt.MVPA -0.316432232 0.06825280 -0.28766646 1.000000000  
## Avg.Frag 0.247469912 -0.06344020 -0.02789109 -0.052511215  
## Avg.Eff -0.050628405 0.04032396 0.12924936 -0.186802321  
## Avg.Dur 0.191478758 0.06168843 0.17358708 -0.029682809  
## Avg.Lat 0.014965691 0.05952899 0.11324245 0.000503158  
## Avg.Awake -0.001054879 -0.07876104 0.01080156 0.125995731  
## Avg.Frag Avg.Eff Avg.Dur Avg.Lat  
## Age 0.24746991 -0.05062840 0.19147876 0.014965691  
## PSQI.Total -0.06344020 0.04032396 0.06168843 0.059528994  
## ADAS.Cog.Plus -0.02789109 0.12924936 0.17358708 0.113242451  
## Avg.Pcnt.MVPA -0.05251122 -0.18680232 -0.02968281 0.000503158  
## Avg.Frag 1.00000000 -0.74776045 -0.29344451 0.239938897  
## Avg.Eff -0.74776045 1.00000000 0.53046049 -0.366718051  
## Avg.Dur -0.29344451 0.53046049 1.00000000 -0.138472025  
## Avg.Lat 0.23993890 -0.36671805 -0.13847202 1.000000000  
## Avg.Awake 0.58612660 -0.61709556 -0.04505525 0.197843670  
## Avg.Awake  
## Age -0.001054879  
## PSQI.Total -0.078761042  
## ADAS.Cog.Plus 0.010801560  
## Avg.Pcnt.MVPA 0.125995731  
## Avg.Frag 0.586126597  
## Avg.Eff -0.617095556  
## Avg.Dur -0.045055246  
## Avg.Lat 0.197843670  
## Avg.Awake 1.000000000

cor.test(Correlation$Avg.Dur, Correlation$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation$Avg.Dur and Correlation$Age  
## t = 2.0844, df = 135, p-value = 0.03901  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## 0.009129892 0.334387810  
## sample estimates:  
## cor   
## 0.176575

#Correlations for Outliers removed accounting for Awakenings#  
cor.test(Correlation.PSQI$PSQI.Total, Correlation.PSQI$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.PSQI$PSQI.Total and Correlation.PSQI$Age  
## t = -0.94565, df = 134, p-value = 0.346  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.24637650 0.08812024  
## sample estimates:  
## cor   
## -0.08142039

cor.test(Correlation$ADAS.Cog.Plus, Correlation$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation$ADAS.Cog.Plus and Correlation$Age  
## t = 4.549, df = 135, p-value = 1.188e-05  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## 0.2096786 0.5016176  
## sample estimates:  
## cor   
## 0.3645733

cor.test(Correlation$Avg.Pcnt.MVPA, Correlation$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation$Avg.Pcnt.MVPA and Correlation$Age  
## t = -3.7771, df = 135, p-value = 0.000237  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.4533642 -0.1491751  
## sample estimates:  
## cor   
## -0.3091558

pcor.test(Correlation$Avg.Frag, Correlation$Age, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.3143838 0.0001934351 3.833637 137 1 pearson

pcor.test(Correlation$Avg.Eff, Correlation$Age, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.07298885 0.3984128 -0.8471666 137 1 pearson

cor.test(Correlation$Avg.Dur, Correlation$Age)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation$Avg.Dur and Correlation$Age  
## t = 2.0844, df = 135, p-value = 0.03901  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## 0.009129892 0.334387810  
## sample estimates:  
## cor   
## 0.176575

pcor.test(Correlation$Avg.Lat, Correlation$Age, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.008211427 0.9244113 0.09505734 137 1 pearson

cor.test(Correlation.PSQI$ADAS.Cog.Plus, Correlation.PSQI$PSQI.Total)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.PSQI$ADAS.Cog.Plus and Correlation.PSQI$PSQI.Total  
## t = 0.56404, df = 134, p-value = 0.5737  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1206536 0.2152373  
## sample estimates:  
## cor   
## 0.04866775

cor.test(Correlation.PSQI$Avg.Pcnt.MVPA, Correlation.PSQI$PSQI.Total)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.PSQI$Avg.Pcnt.MVPA and Correlation.PSQI$PSQI.Total  
## t = 0.79193, df = 134, p-value = 0.4298  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1012433 0.2338984  
## sample estimates:  
## cor   
## 0.0682528

pcor.test(Correlation.PSQI$Avg.Frag, Correlation.PSQI$PSQI.Total, Correlation.PSQI$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.02138938 0.805497 -0.2467308 136 1 pearson

pcor.test(Correlation.PSQI$Avg.Eff, Correlation.PSQI$PSQI.Total, Correlation.PSQI$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.01055414 0.9033021 -0.121723 136 1 pearson

cor.test(Correlation.PSQI$Avg.Dur, Correlation.PSQI$PSQI.Total)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation.PSQI$Avg.Dur and Correlation.PSQI$PSQI.Total  
## t = 0.71546, df = 134, p-value = 0.4756  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.1077635 0.2276573  
## sample estimates:  
## cor   
## 0.06168843

pcor.test(Correlation.PSQI$Avg.Lat, Correlation.PSQI$PSQI.Total, Correlation.PSQI$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.07686477 0.3755664 0.889078 136 1 pearson

cor.test(Correlation$Avg.Pcnt.MVPA, Correlation$ADAS.Cog.Plus)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation$Avg.Pcnt.MVPA and Correlation$ADAS.Cog.Plus  
## t = -3.4384, df = 135, p-value = 0.0007785  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.4309706 -0.1218494  
## sample estimates:  
## cor   
## -0.2837659

pcor.test(Correlation$Avg.Frag, Correlation$ADAS.Cog.Plus, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.03482802 0.6872909 -0.4034082 137 1 pearson

pcor.test(Correlation$Avg.Eff, Correlation$ADAS.Cog.Plus, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.1668126 0.05225594 1.958436 137 1 pearson

cor.test(Correlation$Avg.Dur, Correlation$ADAS.Cog.Plus)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation$Avg.Dur and Correlation$ADAS.Cog.Plus  
## t = 1.9397, df = 135, p-value = 0.0545  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.003134451 0.323450264  
## sample estimates:  
## cor   
## 0.1646676

pcor.test(Correlation$Avg.Lat, Correlation$ADAS.Cog.Plus, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.1085826 0.2082774 1.264411 137 1 pearson

pcor.test(Correlation$Avg.Frag, Correlation$Avg.Pcnt.MVPA, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.1502582 0.08080238 -1.759338 137 1 pearson

pcor.test(Correlation$Avg.Eff, Correlation$Avg.Pcnt.MVPA, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.1432221 0.0962298 -1.675186 137 1 pearson

cor.test(Correlation$Avg.Dur, Correlation$Avg.Pcnt.MVPA)

##   
## Pearson's product-moment correlation  
##   
## data: Correlation$Avg.Dur and Correlation$Avg.Pcnt.MVPA  
## t = -0.40331, df = 135, p-value = 0.6874  
## alternative hypothesis: true correlation is not equal to 0  
## 95 percent confidence interval:  
## -0.2012352 0.1338035  
## sample estimates:  
## cor   
## -0.03469049

pcor.test(Correlation$Avg.Lat, Correlation$Avg.Pcnt.MVPA, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.02854474 0.7414902 -0.3305639 137 1 pearson

pcor.test(Correlation$Avg.Eff, Correlation$Avg.Frag, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.6085133 3.895157e-15 -8.876702 137 1 pearson

pcor.test(Correlation$Avg.Dur, Correlation$Avg.Frag, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.3383303 5.610486e-05 -4.161894 137 1 pearson

pcor.test(Correlation$Avg.Lat, Correlation$Avg.Frag, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.1478262 0.08589305 1.730221 137 1 pearson

pcor.test(Correlation$Avg.Dur, Correlation$Avg.Eff, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 0.6421573 3.594661e-17 9.697067 137 1 pearson

pcor.test(Correlation$Avg.Lat, Correlation$Avg.Eff, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.3105283 0.0002338649 -3.78157 137 1 pearson

pcor.test(Correlation$Avg.Dur, Correlation$Avg.Lat, Correlation$Avg.Awake)

## estimate p.value statistic n gp Method  
## 1 -0.1235115 0.1519791 -1.440781 137 1 pearson

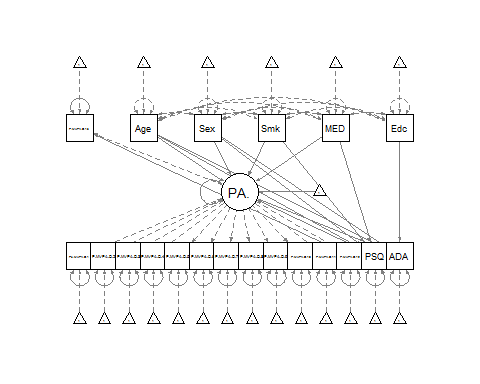
#----------------Primary Analyses-------------------  
#STRUCTURAL EQUATION MODELS  
#---------------------------------------------------  
  
#~~~~~PSQI Model: Full data set~~~~~~~~~~~~~~~~~~~~~#  
sleep.PSQI <- '  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
  
#regressions#   
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
PSQI.Total ~ Age + Sex + Smoking + MED.SLEEP  
  
#Correlations among PA Days#  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
  
##Covariance between PA and PSQI##  
PA.I ~~ PSQI.Total  
  
##Relationship of PA and PSQI with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + PSQI.Total + Age + Sex + Education  
'  
model.sleep.PSQI <- growth(sleep.PSQI, data = PA\_Sleep)  
summary(model.sleep.PSQI, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 135 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 43  
##   
## Used Total  
## Number of observations 145 146  
##   
## Model Test User Model:  
##   
## Test statistic 392.836  
## Degrees of freedom 167  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2669.348  
## Degrees of freedom 180  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.909  
## Tucker-Lewis Index (TLI) 0.902  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -5877.100  
## Loglikelihood unrestricted model (H1) -5680.682  
##   
## Akaike (AIC) 11840.199  
## Bayesian (BIC) 11968.199  
## Sample-size adjusted Bayesian (BIC) 11832.132  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.097  
## 90 Percent confidence interval - lower 0.084  
## 90 Percent confidence interval - upper 0.109  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.057  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 6.001 0.818  
## Pcnt.MVPA.Dy.2 1.000 6.001 0.794  
## Pcnt.MVPA.Dy.3 1.000 6.001 0.739  
## Pcnt.MVPA.Dy.4 1.000 6.001 0.753  
## Pcnt.MVPA.Dy.5 1.000 6.001 0.800  
## Pcnt.MVPA.Dy.6 1.000 6.001 0.846  
## Pcnt.MVPA.Dy.7 1.000 6.001 0.819  
## Pcnt.MVPA.Dy.8 1.000 6.001 0.815  
## Pcnt.MVPA.Dy.9 1.000 6.001 0.824  
## Pcnt.MVPA.D.10 1.000 6.001 0.762  
## Pcnt.MVPA.D.11 1.000 6.001 0.818  
## Pcnt.MVPA.D.12 1.000 6.001 0.811  
## Pcnt.MVPA.D.13 1.000 6.001 0.817  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I ~   
## Age -0.277 0.065 -4.237 0.000 -0.046 -0.334  
## Sex -1.855 1.005 -1.846 0.065 -0.309 -0.146  
## Smoking -0.791 0.891 -0.888 0.375 -0.132 -0.069  
## MED.SLEEP 0.831 1.394 0.596 0.551 0.139 0.047  
## PSQI.Total ~   
## Age 0.093 0.007 14.151 0.000 0.093 0.161  
## Sex -1.330 0.628 -2.117 0.034 -1.330 -0.151  
## Smoking 0.432 0.552 0.783 0.434 0.432 0.055  
## MED.SLEEP 5.755 0.876 6.573 0.000 5.755 0.467  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.043 0.030 1.423 0.155 0.043 0.044  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.106 0.026 4.024 0.000 0.106 0.114  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.154 0.030 5.154 0.000 0.154 0.151  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.138 0.032 4.370 0.000 0.138 0.130  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.078 0.031 2.538 0.011 0.078 0.074  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.085 0.026 3.281 0.001 0.085 0.088  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.077 0.029 2.616 0.009 0.077 0.077  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.057 0.031 1.850 0.064 0.057 0.056  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.066 0.028 2.372 0.018 0.066 0.071  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.105 0.033 3.156 0.002 0.105 0.098  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.058 0.030 1.917 0.055 0.058 0.059  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.067 0.032 2.114 0.035 0.067 0.067  
## ADAS.Cog.Plus ~   
## PA.I -0.027 0.008 -3.317 0.001 -0.159 -0.228  
## PSQI.Total -0.004 0.012 -0.298 0.766 -0.004 -0.021  
## Age 0.001 0.003 0.534 0.593 0.001 0.014  
## Sex 0.439 0.108 4.069 0.000 0.439 0.297  
## Education -0.182 0.035 -5.212 0.000 -0.182 -0.342  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PA.I ~~   
## .PSQI.Total -2.058 1.652 -1.246 0.213 -0.373 -0.106  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .PSQI.Total 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .PA.I 30.200 4.724 6.393 0.000 5.032 5.032  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 14.227 1.792 7.939 0.000 14.227 0.264  
## .Pcnt.MVPA.Dy.2 11.388 1.462 7.789 0.000 11.388 0.199  
## .Pcnt.MVPA.Dy.3 15.626 1.957 7.984 0.000 15.626 0.237  
## .Pcnt.MVPA.Dy.4 15.638 1.958 7.986 0.000 15.638 0.246  
## .Pcnt.MVPA.Dy.5 13.715 1.733 7.912 0.000 13.715 0.244  
## .Pcnt.MVPA.Dy.6 7.323 0.991 7.387 0.000 7.323 0.145  
## .Pcnt.MVPA.Dy.7 11.470 1.473 7.784 0.000 11.470 0.214  
## .Pcnt.MVPA.Dy.8 13.629 1.724 7.905 0.000 13.629 0.251  
## .Pcnt.MVPA.Dy.9 11.442 1.469 7.792 0.000 11.442 0.216  
## .Pcnt.MVPA.D.10 17.273 2.150 8.033 0.000 17.273 0.279  
## .Pcnt.MVPA.D.11 13.122 1.664 7.885 0.000 13.122 0.244  
## .Pcnt.MVPA.D.12 13.582 1.718 7.905 0.000 13.582 0.248  
## .Pcnt.MVPA.D.13 17.898 2.223 8.050 0.000 17.898 0.332  
## .PSQI.Total 12.426 1.459 8.515 0.000 12.426 0.720  
## .ADAS.Cog.Plus 0.342 0.040 8.497 0.000 0.342 0.700  
## .PA.I 30.495 3.907 7.804 0.000 0.847 0.847  
##   
## R-Square:  
## Estimate  
## Pcnt.MVPA.Dy.1 0.736  
## Pcnt.MVPA.Dy.2 0.801  
## Pcnt.MVPA.Dy.3 0.763  
## Pcnt.MVPA.Dy.4 0.754  
## Pcnt.MVPA.Dy.5 0.756  
## Pcnt.MVPA.Dy.6 0.855  
## Pcnt.MVPA.Dy.7 0.786  
## Pcnt.MVPA.Dy.8 0.749  
## Pcnt.MVPA.Dy.9 0.784  
## Pcnt.MVPA.D.10 0.721  
## Pcnt.MVPA.D.11 0.756  
## Pcnt.MVPA.D.12 0.752  
## Pcnt.MVPA.D.13 0.668  
## PSQI.Total 0.280  
## ADAS.Cog.Plus 0.300  
## PA.I 0.153

semPaths(model.sleep.PSQI, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")  
  
  
#~~~~~~~~~~~~~~~PSQI Model Outliers Removed~~~~~~~~~~~~#  
sleep.PSQI <- '  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
  
#regressions#   
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
PSQI.Total ~ Age + Sex + Smoking + MED.SLEEP  
  
  
#Correlations among PA Days#  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
  
##Covariance between PA and PSQI##  
PA.I ~~ PSQI.Total  
  
##Relationship of PA and PSQI with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + PSQI.Total + Age + Sex + Education  
'  
model.sleep.PSQI <- growth(sleep.PSQI, data = PA\_Sleep.1)  
summary(model.sleep.PSQI, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 131 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 43  
##   
## Used Total  
## Number of observations 136 137  
##   
## Model Test User Model:  
##   
## Test statistic 387.297  
## Degrees of freedom 167  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2305.505  
## Degrees of freedom 180  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.896  
## Tucker-Lewis Index (TLI) 0.888  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -5439.713  
## Loglikelihood unrestricted model (H1) -5246.065  
##   
## Akaike (AIC) 10965.426  
## Bayesian (BIC) 11090.670  
## Sample-size adjusted Bayesian (BIC) 10954.641  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.098  
## 90 Percent confidence interval - lower 0.086  
## 90 Percent confidence interval - upper 0.111  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.057  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.506 0.805  
## Pcnt.MVPA.Dy.2 1.000 5.506 0.822  
## Pcnt.MVPA.Dy.3 1.000 5.506 0.761  
## Pcnt.MVPA.Dy.4 1.000 5.506 0.802  
## Pcnt.MVPA.Dy.5 1.000 5.506 0.835  
## Pcnt.MVPA.Dy.6 1.000 5.506 0.867  
## Pcnt.MVPA.Dy.7 1.000 5.506 0.820  
## Pcnt.MVPA.Dy.8 1.000 5.506 0.819  
## Pcnt.MVPA.Dy.9 1.000 5.506 0.822  
## Pcnt.MVPA.D.10 1.000 5.506 0.759  
## Pcnt.MVPA.D.11 1.000 5.506 0.850  
## Pcnt.MVPA.D.12 1.000 5.506 0.805  
## Pcnt.MVPA.D.13 1.000 5.506 0.798  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I ~   
## Age -0.246 0.061 -4.004 0.000 -0.045 -0.321  
## Sex -2.213 0.950 -2.331 0.020 -0.402 -0.188  
## Smoking -0.755 0.831 -0.908 0.364 -0.137 -0.072  
## MED.SLEEP 2.089 1.336 1.563 0.118 0.379 0.125  
## PSQI.Total ~   
## Age 0.093 0.007 13.716 0.000 0.093 0.162  
## Sex -1.114 0.662 -1.683 0.092 -1.114 -0.126  
## Smoking 0.439 0.574 0.765 0.444 0.439 0.056  
## MED.SLEEP 5.631 0.934 6.029 0.000 5.631 0.450  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.033 0.033 1.005 0.315 0.033 0.032  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.059 0.028 2.092 0.036 0.059 0.064  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.102 0.033 3.068 0.002 0.102 0.097  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.056 0.033 1.673 0.094 0.056 0.053  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.018 0.032 0.556 0.578 0.018 0.017  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.045 0.027 1.663 0.096 0.045 0.047  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.058 0.031 1.876 0.061 0.058 0.058  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.026 0.032 0.807 0.420 0.026 0.026  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.051 0.029 1.776 0.076 0.051 0.056  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.094 0.036 2.624 0.009 0.094 0.084  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.007 0.030 0.236 0.814 0.007 0.008  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.054 0.033 1.650 0.099 0.054 0.055  
## ADAS.Cog.Plus ~   
## PA.I -0.028 0.009 -3.197 0.001 -0.152 -0.230  
## PSQI.Total 0.004 0.012 0.356 0.722 0.004 0.027  
## Age 0.000 0.003 0.185 0.853 0.000 0.005  
## Sex 0.407 0.108 3.778 0.000 0.407 0.288  
## Education -0.171 0.035 -4.899 0.000 -0.171 -0.334  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PA.I ~~   
## .PSQI.Total -1.160 1.556 -0.746 0.456 -0.232 -0.065  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .PSQI.Total 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .PA.I 27.866 4.438 6.279 0.000 5.061 5.061  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 14.257 1.845 7.728 0.000 14.257 0.305  
## .Pcnt.MVPA.Dy.2 10.405 1.382 7.531 0.000 10.405 0.232  
## .Pcnt.MVPA.Dy.3 14.981 1.934 7.746 0.000 14.981 0.286  
## .Pcnt.MVPA.Dy.4 13.281 1.728 7.685 0.000 13.281 0.282  
## .Pcnt.MVPA.Dy.5 12.011 1.575 7.625 0.000 12.011 0.276  
## .Pcnt.MVPA.Dy.6 7.044 0.980 7.188 0.000 7.044 0.175  
## .Pcnt.MVPA.Dy.7 10.999 1.455 7.560 0.000 10.999 0.244  
## .Pcnt.MVPA.Dy.8 13.217 1.721 7.679 0.000 13.217 0.292  
## .Pcnt.MVPA.Dy.9 10.967 1.449 7.566 0.000 10.967 0.245  
## .Pcnt.MVPA.D.10 16.163 2.077 7.783 0.000 16.163 0.307  
## .Pcnt.MVPA.D.11 11.225 1.480 7.583 0.000 11.225 0.267  
## .Pcnt.MVPA.D.12 13.099 1.707 7.675 0.000 13.099 0.280  
## .Pcnt.MVPA.D.13 17.232 2.206 7.812 0.000 17.232 0.362  
## .PSQI.Total 12.657 1.535 8.246 0.000 12.657 0.740  
## .ADAS.Cog.Plus 0.313 0.038 8.228 0.000 0.313 0.714  
## .PA.I 24.965 3.312 7.538 0.000 0.823 0.823  
##   
## R-Square:  
## Estimate  
## Pcnt.MVPA.Dy.1 0.695  
## Pcnt.MVPA.Dy.2 0.768  
## Pcnt.MVPA.Dy.3 0.714  
## Pcnt.MVPA.Dy.4 0.718  
## Pcnt.MVPA.Dy.5 0.724  
## Pcnt.MVPA.Dy.6 0.825  
## Pcnt.MVPA.Dy.7 0.756  
## Pcnt.MVPA.Dy.8 0.708  
## Pcnt.MVPA.Dy.9 0.755  
## Pcnt.MVPA.D.10 0.693  
## Pcnt.MVPA.D.11 0.733  
## Pcnt.MVPA.D.12 0.720  
## Pcnt.MVPA.D.13 0.638  
## PSQI.Total 0.260  
## ADAS.Cog.Plus 0.286  
## PA.I 0.177

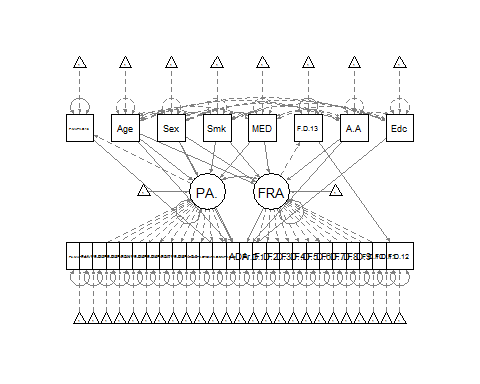
semPaths(model.sleep.PSQI, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")



#~~~~~~~~~~~~~~~~~~~~~Fragmentation Model Full Data Set~~~~~~~~~~~~~~~~~~#  
sleep.FragAwake.2 <- '  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
FRAG.I =~ 1\*Fragmentation.Day.1 + 1\*Fragmentation.Day.2 + 1\*Fragmentation.Day.3 + 1\*Fragmentation.Day.4 + 1\*Fragmentation.Day.5 + 1\*Fragmentation.Day.6 + 1\*Fragmentation.Day.7 + 1\*Fragmentation.Day.8 + 1\*Fragmentation.Day.9 + 1\*Fragmentation.Day.10 + 1\*Fragmentation.Day.11 + 1\*Fragmentation.Day.12 + 1\*Fragmentation.Day.13  
  
#regressions#   
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
FRAG.I ~ Age + Sex + Smoking + MED.SLEEP + Avg.Awake  
  
##Correlations between days for latent factors##  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
Fragmentation.Day.1 ~ Fragmentation.Day.2  
Fragmentation.Day.2 ~ Fragmentation.Day.3  
Fragmentation.Day.3 ~ Fragmentation.Day.4  
Fragmentation.Day.4 ~ Fragmentation.Day.5  
Fragmentation.Day.5 ~ Fragmentation.Day.6  
Fragmentation.Day.6 ~ Fragmentation.Day.7  
Fragmentation.Day.7 ~ Fragmentation.Day.8  
Fragmentation.Day.8 ~ Fragmentation.Day.9  
Fragmentation.Day.9 ~ Fragmentation.Day.10  
Fragmentation.Day.10 ~ Fragmentation.Day.11  
Fragmentation.Day.11 ~ Fragmentation.Day.12  
Fragmentation.Day.12 ~ Fragmentation.Day.13  
  
  
##Relationship of PA and PSQI with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + FRAG.I + Avg.Awake + Age + Sex + Education  
  
##Covariation between slopes##  
PA.I ~~ FRAG.I  
'  
model.sleep.FragAwake.2 <- growth(sleep.FragAwake.2, data = PA\_Sleep)  
summary(model.sleep.FragAwake.2, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 182 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 71  
##   
## Used Total  
## Number of observations 145 146  
##   
## Model Test User Model:  
##   
## Test statistic 777.920  
## Degrees of freedom 496  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 4227.946  
## Degrees of freedom 513  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.924  
## Tucker-Lewis Index (TLI) 0.922  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12583.362  
## Loglikelihood unrestricted model (H1) -12194.402  
##   
## Akaike (AIC) 25308.724  
## Bayesian (BIC) 25520.072  
## Sample-size adjusted Bayesian (BIC) 25295.403  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.063  
## 90 Percent confidence interval - lower 0.054  
## 90 Percent confidence interval - upper 0.071  
## P-value RMSEA <= 0.05 0.009  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.071  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.931 0.819  
## Pcnt.MVPA.Dy.2 1.000 5.931 0.791  
## Pcnt.MVPA.Dy.3 1.000 5.931 0.737  
## Pcnt.MVPA.Dy.4 1.000 5.931 0.751  
## Pcnt.MVPA.Dy.5 1.000 5.931 0.798  
## Pcnt.MVPA.Dy.6 1.000 5.931 0.843  
## Pcnt.MVPA.Dy.7 1.000 5.931 0.820  
## Pcnt.MVPA.Dy.8 1.000 5.931 0.813  
## Pcnt.MVPA.Dy.9 1.000 5.931 0.822  
## Pcnt.MVPA.D.10 1.000 5.931 0.759  
## Pcnt.MVPA.D.11 1.000 5.931 0.815  
## Pcnt.MVPA.D.12 1.000 5.931 0.810  
## Pcnt.MVPA.D.13 1.000 5.931 0.814  
## FRAG.I =~   
## Fragmnttn.Dy.1 1.000 10.709 0.761  
## Fragmnttn.Dy.2 1.000 10.709 0.690  
## Fragmnttn.Dy.3 1.000 10.709 0.691  
## Fragmnttn.Dy.4 1.000 10.709 0.793  
## Fragmnttn.Dy.5 1.000 10.709 0.730  
## Fragmnttn.Dy.6 1.000 10.709 0.716  
## Fragmnttn.Dy.7 1.000 10.709 0.765  
## Fragmnttn.Dy.8 1.000 10.709 0.733  
## Fragmnttn.Dy.9 1.000 10.709 0.720  
## Frgmnttn.Dy.10 1.000 10.709 0.740  
## Frgmnttn.Dy.11 1.000 10.709 0.759  
## Frgmnttn.Dy.12 1.000 10.709 0.736  
## Frgmnttn.Dy.13 1.000 10.709 0.749  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv  
## PA.I ~   
## Age -0.246 0.066 -3.726 0.000 -0.041  
## Sex -1.799 1.006 -1.788 0.074 -0.303  
## Smoking -0.859 0.892 -0.962 0.336 -0.145  
## MED.SLEEP 0.942 1.396 0.674 0.500 0.159  
## FRAG.I ~   
## Age 0.392 0.090 4.375 0.000 0.037  
## Sex -1.433 1.428 -1.004 0.315 -0.134  
## Smoking 1.889 1.213 1.557 0.119 0.176  
## MED.SLEEP 0.604 1.900 0.318 0.751 0.056  
## Avg.Awake 1.037 0.091 11.349 0.000 0.097  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.039 0.030 1.305 0.192 0.039  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.107 0.027 4.027 0.000 0.107  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.155 0.030 5.180 0.000 0.155  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.138 0.032 4.342 0.000 0.138  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.078 0.031 2.509 0.012 0.078  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.088 0.026 3.375 0.001 0.088  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.072 0.030 2.447 0.014 0.072  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.057 0.031 1.825 0.068 0.057  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.066 0.028 2.364 0.018 0.066  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.107 0.034 3.188 0.001 0.107  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.060 0.031 1.948 0.051 0.060  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.066 0.032 2.048 0.041 0.066  
## Fragmentation.Day.1 ~   
## Fragmnttn.Dy.2 0.016 0.027 0.609 0.543 0.016  
## Fragmentation.Day.2 ~   
## Fragmnttn.Dy.3 -0.003 0.031 -0.094 0.925 -0.003  
## Fragmentation.Day.3 ~   
## Fragmnttn.Dy.4 0.046 0.032 1.436 0.151 0.046  
## Fragmentation.Day.4 ~   
## Fragmnttn.Dy.5 -0.016 0.026 -0.623 0.533 -0.016  
## Fragmentation.Day.5 ~   
## Fragmnttn.Dy.6 0.040 0.028 1.449 0.147 0.040  
## Fragmentation.Day.6 ~   
## Fragmnttn.Dy.7 0.029 0.030 0.978 0.328 0.029  
## Fragmentation.Day.7 ~   
## Fragmnttn.Dy.8 0.002 0.027 0.082 0.934 0.002  
## Fragmentation.Day.8 ~   
## Fragmnttn.Dy.9 0.020 0.028 0.707 0.480 0.020  
## Fragmentation.Day.9 ~   
## Frgmnttn.Dy.10 0.025 0.029 0.866 0.386 0.025  
## Fragmentation.Day.10 ~   
## Frgmnttn.Dy.11 0.029 0.029 1.029 0.304 0.029  
## Fragmentation.Day.11 ~   
## Frgmnttn.Dy.12 -0.005 0.028 -0.189 0.850 -0.005  
## Fragmentation.Day.12 ~   
## Frgmnttn.Dy.13 -0.006 0.030 -0.220 0.826 -0.006  
## ADAS.Cog.Plus ~   
## PA.I -0.022 0.008 -2.666 0.008 -0.129  
## FRAG.I -0.009 0.007 -1.365 0.172 -0.100  
## Avg.Awake -0.009 0.009 -0.945 0.345 -0.009  
## Age 0.007 0.003 2.408 0.016 0.007  
## Sex 0.521 0.107 4.886 0.000 0.521  
## Education -0.183 0.034 -5.382 0.000 -0.183  
## Std.all  
##   
## -0.299  
## -0.143  
## -0.076  
## 0.054  
##   
## 0.264  
## -0.063  
## 0.093  
## 0.019  
## 0.711  
##   
## 0.041  
##   
## 0.115  
##   
## 0.152  
##   
## 0.130  
##   
## 0.074  
##   
## 0.090  
##   
## 0.073  
##   
## 0.056  
##   
## 0.071  
##   
## 0.100  
##   
## 0.060  
##   
## 0.065  
##   
## 0.018  
##   
## -0.003  
##   
## 0.040  
##   
## -0.017  
##   
## 0.041  
##   
## 0.027  
##   
## 0.002  
##   
## 0.020  
##   
## 0.024  
##   
## 0.029  
##   
## -0.006  
##   
## -0.006  
##   
## -0.187  
## -0.145  
## -0.091  
## 0.077  
## 0.356  
## -0.347  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PA.I ~~   
## .FRAG.I -4.986 3.592 -1.388 0.165 -0.126 -0.126  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .Fragmnttn.Dy.1 0.000 0.000 0.000  
## .Fragmnttn.Dy.2 0.000 0.000 0.000  
## .Fragmnttn.Dy.3 0.000 0.000 0.000  
## .Fragmnttn.Dy.4 0.000 0.000 0.000  
## .Fragmnttn.Dy.5 0.000 0.000 0.000  
## .Fragmnttn.Dy.6 0.000 0.000 0.000  
## .Fragmnttn.Dy.7 0.000 0.000 0.000  
## .Fragmnttn.Dy.8 0.000 0.000 0.000  
## .Fragmnttn.Dy.9 0.000 0.000 0.000  
## .Frgmnttn.Dy.10 0.000 0.000 0.000  
## .Frgmnttn.Dy.11 0.000 0.000 0.000  
## .Frgmnttn.Dy.12 0.000 0.000 0.000  
## .Frgmnttn.Dy.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .PA.I 27.857 4.756 5.857 0.000 4.697 4.697  
## .FRAG.I -25.676 6.939 -3.700 0.000 -2.398 -2.398  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 14.116 1.779 7.935 0.000 14.116 0.269  
## .Pcnt.MVPA.Dy.2 11.406 1.464 7.791 0.000 11.406 0.203  
## .Pcnt.MVPA.Dy.3 15.574 1.951 7.982 0.000 15.574 0.240  
## .Pcnt.MVPA.Dy.4 15.634 1.958 7.986 0.000 15.634 0.250  
## .Pcnt.MVPA.Dy.5 13.738 1.736 7.913 0.000 13.738 0.249  
## .Pcnt.MVPA.Dy.6 7.289 0.987 7.383 0.000 7.289 0.147  
## .Pcnt.MVPA.Dy.7 11.456 1.472 7.783 0.000 11.456 0.219  
## .Pcnt.MVPA.Dy.8 13.571 1.717 7.903 0.000 13.571 0.255  
## .Pcnt.MVPA.Dy.9 11.463 1.471 7.793 0.000 11.463 0.220  
## .Pcnt.MVPA.D.10 17.273 2.150 8.034 0.000 17.273 0.283  
## .Pcnt.MVPA.D.11 13.142 1.666 7.887 0.000 13.142 0.248  
## .Pcnt.MVPA.D.12 13.545 1.714 7.904 0.000 13.545 0.253  
## .Pcnt.MVPA.D.13 17.890 2.222 8.050 0.000 17.890 0.337  
## .Fragmnttn.Dy.1 79.402 10.118 7.848 0.000 79.402 0.401  
## .Fragmnttn.Dy.2 126.942 15.688 8.092 0.000 126.942 0.527  
## .Fragmnttn.Dy.3 114.788 14.258 8.051 0.000 114.788 0.478  
## .Fragmnttn.Dy.4 71.654 9.221 7.771 0.000 71.654 0.393  
## .Fragmnttn.Dy.5 90.688 11.445 7.924 0.000 90.688 0.421  
## .Fragmnttn.Dy.6 102.299 12.800 7.992 0.000 102.299 0.457  
## .Fragmnttn.Dy.7 81.007 10.311 7.856 0.000 81.007 0.413  
## .Fragmnttn.Dy.8 93.982 11.829 7.945 0.000 93.982 0.440  
## .Fragmnttn.Dy.9 100.582 12.599 7.983 0.000 100.582 0.454  
## .Frgmnttn.Dy.10 87.648 11.086 7.906 0.000 87.648 0.419  
## .Frgmnttn.Dy.11 85.770 10.869 7.891 0.000 85.770 0.430  
## .Frgmnttn.Dy.12 98.625 12.371 7.972 0.000 98.625 0.466  
## .Frgmnttn.Dy.13 89.915 11.352 7.921 0.000 89.915 0.439  
## .ADAS.Cog.Plus 0.321 0.038 8.486 0.000 0.321 0.671  
## .PA.I 30.590 3.921 7.802 0.000 0.870 0.870  
## .FRAG.I 51.278 7.134 7.188 0.000 0.447 0.447  
##   
## R-Square:  
## Estimate  
## Pcnt.MVPA.Dy.1 0.731  
## Pcnt.MVPA.Dy.2 0.797  
## Pcnt.MVPA.Dy.3 0.760  
## Pcnt.MVPA.Dy.4 0.750  
## Pcnt.MVPA.Dy.5 0.751  
## Pcnt.MVPA.Dy.6 0.853  
## Pcnt.MVPA.Dy.7 0.781  
## Pcnt.MVPA.Dy.8 0.745  
## Pcnt.MVPA.Dy.9 0.780  
## Pcnt.MVPA.D.10 0.717  
## Pcnt.MVPA.D.11 0.752  
## Pcnt.MVPA.D.12 0.747  
## Pcnt.MVPA.D.13 0.663  
## Fragmnttn.Dy.1 0.599  
## Fragmnttn.Dy.2 0.473  
## Fragmnttn.Dy.3 0.522  
## Fragmnttn.Dy.4 0.607  
## Fragmnttn.Dy.5 0.579  
## Fragmnttn.Dy.6 0.543  
## Fragmnttn.Dy.7 0.587  
## Fragmnttn.Dy.8 0.560  
## Fragmnttn.Dy.9 0.546  
## Frgmnttn.Dy.10 0.581  
## Frgmnttn.Dy.11 0.570  
## Frgmnttn.Dy.12 0.534  
## Frgmnttn.Dy.13 0.561  
## ADAS.Cog.Plus 0.329  
## PA.I 0.130  
## FRAG.I 0.553

semPaths(model.sleep.FragAwake.2, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")



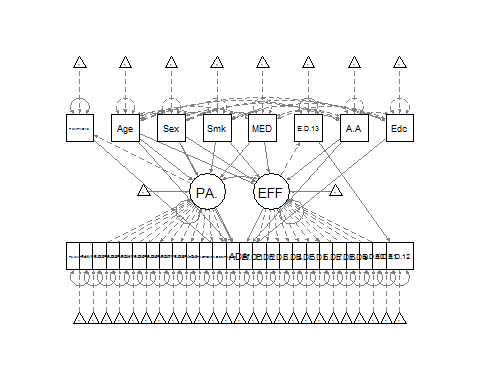
#~~~~~~~~~~~~~~~~~Fragmentation Model Outliers Removed~~~~~~~~~~~~~~~~~~~~#  
sleep.FragAwake.2 <- '  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
FRAG.I =~ 1\*Fragmentation.Day.1 + 1\*Fragmentation.Day.2 + 1\*Fragmentation.Day.3 + 1\*Fragmentation.Day.4 + 1\*Fragmentation.Day.5 + 1\*Fragmentation.Day.6 + 1\*Fragmentation.Day.7 + 1\*Fragmentation.Day.8 + 1\*Fragmentation.Day.9 + 1\*Fragmentation.Day.10 + 1\*Fragmentation.Day.11 + 1\*Fragmentation.Day.12 + 1\*Fragmentation.Day.13  
  
#regressions#   
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
FRAG.I ~ Age + Sex + Smoking + MED.SLEEP + Avg.Awake  
  
##Correlations between days for latent factors##  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
Fragmentation.Day.1 ~ Fragmentation.Day.2  
Fragmentation.Day.2 ~ Fragmentation.Day.3  
Fragmentation.Day.3 ~ Fragmentation.Day.4  
Fragmentation.Day.4 ~ Fragmentation.Day.5  
Fragmentation.Day.5 ~ Fragmentation.Day.6  
Fragmentation.Day.6 ~ Fragmentation.Day.7  
Fragmentation.Day.7 ~ Fragmentation.Day.8  
Fragmentation.Day.8 ~ Fragmentation.Day.9  
Fragmentation.Day.9 ~ Fragmentation.Day.10  
Fragmentation.Day.10 ~ Fragmentation.Day.11  
Fragmentation.Day.11 ~ Fragmentation.Day.12  
Fragmentation.Day.12 ~ Fragmentation.Day.13  
  
  
##Relationship of PA and PSQI with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + FRAG.I + Avg.Awake + Age + Sex + Education  
  
##Covariation between slopes##  
PA.I ~~ FRAG.I  
'  
model.sleep.FragAwake.2 <- growth(sleep.FragAwake.2, data = PA\_Sleep.1)  
summary(model.sleep.FragAwake.2, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 191 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 71  
##   
## Number of observations 137  
##   
## Model Test User Model:  
##   
## Test statistic 760.608  
## Degrees of freedom 496  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3576.852  
## Degrees of freedom 513  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.914  
## Tucker-Lewis Index (TLI) 0.911  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -11780.396  
## Loglikelihood unrestricted model (H1) -11400.092  
##   
## Akaike (AIC) 23702.793  
## Bayesian (BIC) 23910.111  
## Sample-size adjusted Bayesian (BIC) 23685.498  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.062  
## 90 Percent confidence interval - lower 0.053  
## 90 Percent confidence interval - upper 0.071  
## P-value RMSEA <= 0.05 0.013  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.071  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.464 0.804  
## Pcnt.MVPA.Dy.2 1.000 5.464 0.821  
## Pcnt.MVPA.Dy.3 1.000 5.464 0.761  
## Pcnt.MVPA.Dy.4 1.000 5.464 0.801  
## Pcnt.MVPA.Dy.5 1.000 5.464 0.834  
## Pcnt.MVPA.Dy.6 1.000 5.464 0.866  
## Pcnt.MVPA.Dy.7 1.000 5.464 0.819  
## Pcnt.MVPA.Dy.8 1.000 5.464 0.818  
## Pcnt.MVPA.Dy.9 1.000 5.464 0.821  
## Pcnt.MVPA.D.10 1.000 5.464 0.758  
## Pcnt.MVPA.D.11 1.000 5.464 0.848  
## Pcnt.MVPA.D.12 1.000 5.464 0.804  
## Pcnt.MVPA.D.13 1.000 5.464 0.797  
## FRAG.I =~   
## Fragmnttn.Dy.1 1.000 9.242 0.721  
## Fragmnttn.Dy.2 1.000 9.242 0.631  
## Fragmnttn.Dy.3 1.000 9.242 0.699  
## Fragmnttn.Dy.4 1.000 9.242 0.743  
## Fragmnttn.Dy.5 1.000 9.242 0.694  
## Fragmnttn.Dy.6 1.000 9.242 0.659  
## Fragmnttn.Dy.7 1.000 9.242 0.711  
## Fragmnttn.Dy.8 1.000 9.242 0.683  
## Fragmnttn.Dy.9 1.000 9.242 0.670  
## Frgmnttn.Dy.10 1.000 9.242 0.685  
## Frgmnttn.Dy.11 1.000 9.242 0.749  
## Frgmnttn.Dy.12 1.000 9.242 0.679  
## Frgmnttn.Dy.13 1.000 9.242 0.691  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv  
## PA.I ~   
## Age -0.228 0.061 -3.723 0.000 -0.042  
## Sex -2.179 0.949 -2.298 0.022 -0.399  
## Smoking -0.794 0.829 -0.958 0.338 -0.145  
## MED.SLEEP 2.150 1.335 1.610 0.107 0.393  
## FRAG.I ~   
## Age 0.357 0.088 4.040 0.000 0.039  
## Sex -1.741 1.417 -1.229 0.219 -0.188  
## Smoking 1.292 1.203 1.074 0.283 0.140  
## MED.SLEEP -0.495 1.926 -0.257 0.797 -0.054  
## Avg.Awake 0.896 0.100 8.986 0.000 0.097  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.032 0.033 0.982 0.326 0.032  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.058 0.028 2.066 0.039 0.058  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.102 0.033 3.068 0.002 0.102  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.056 0.033 1.689 0.091 0.056  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.018 0.032 0.551 0.582 0.018  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.045 0.027 1.682 0.093 0.045  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.056 0.031 1.825 0.068 0.056  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.027 0.032 0.825 0.410 0.027  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.052 0.029 1.797 0.072 0.052  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.094 0.036 2.636 0.008 0.094  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.007 0.030 0.245 0.807 0.007  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.054 0.033 1.640 0.101 0.054  
## Fragmentation.Day.1 ~   
## Fragmnttn.Dy.2 0.014 0.028 0.483 0.629 0.014  
## Fragmentation.Day.2 ~   
## Fragmnttn.Dy.3 0.005 0.034 0.141 0.888 0.005  
## Fragmentation.Day.3 ~   
## Fragmnttn.Dy.4 0.021 0.031 0.676 0.499 0.021  
## Fragmentation.Day.4 ~   
## Fragmnttn.Dy.5 -0.019 0.028 -0.692 0.489 -0.019  
## Fragmentation.Day.5 ~   
## Fragmnttn.Dy.6 0.032 0.029 1.116 0.264 0.032  
## Fragmentation.Day.6 ~   
## Fragmnttn.Dy.7 0.042 0.032 1.317 0.188 0.042  
## Fragmentation.Day.7 ~   
## Fragmnttn.Dy.8 0.002 0.029 0.083 0.934 0.002  
## Fragmentation.Day.8 ~   
## Fragmnttn.Dy.9 0.030 0.030 1.023 0.306 0.030  
## Fragmentation.Day.9 ~   
## Frgmnttn.Dy.10 0.029 0.031 0.927 0.354 0.029  
## Fragmentation.Day.10 ~   
## Frgmnttn.Dy.11 0.028 0.032 0.877 0.381 0.028  
## Fragmentation.Day.11 ~   
## Frgmnttn.Dy.12 -0.031 0.028 -1.105 0.269 -0.031  
## Fragmentation.Day.12 ~   
## Frgmnttn.Dy.13 0.003 0.031 0.088 0.930 0.003  
## ADAS.Cog.Plus ~   
## PA.I -0.024 0.009 -2.701 0.007 -0.131  
## FRAG.I -0.010 0.007 -1.339 0.181 -0.090  
## Avg.Awake -0.005 0.009 -0.506 0.613 -0.005  
## Age 0.006 0.003 1.865 0.062 0.006  
## Sex 0.445 0.108 4.111 0.000 0.445  
## Education -0.172 0.035 -4.981 0.000 -0.172  
## Std.all  
##   
## -0.301  
## -0.186  
## -0.077  
## 0.130  
##   
## 0.279  
## -0.088  
## 0.074  
## -0.018  
## 0.642  
##   
## 0.032  
##   
## 0.063  
##   
## 0.097  
##   
## 0.054  
##   
## 0.017  
##   
## 0.048  
##   
## 0.057  
##   
## 0.026  
##   
## 0.056  
##   
## 0.084  
##   
## 0.008  
##   
## 0.054  
##   
## 0.016  
##   
## 0.004  
##   
## 0.020  
##   
## -0.021  
##   
## 0.034  
##   
## 0.039  
##   
## 0.002  
##   
## 0.031  
##   
## 0.028  
##   
## 0.026  
##   
## -0.034  
##   
## 0.003  
##   
## -0.198  
## -0.136  
## -0.047  
## 0.066  
## 0.316  
## -0.336  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PA.I ~~   
## .FRAG.I -3.256 3.202 -1.017 0.309 -0.095 -0.095  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .Fragmnttn.Dy.1 0.000 0.000 0.000  
## .Fragmnttn.Dy.2 0.000 0.000 0.000  
## .Fragmnttn.Dy.3 0.000 0.000 0.000  
## .Fragmnttn.Dy.4 0.000 0.000 0.000  
## .Fragmnttn.Dy.5 0.000 0.000 0.000  
## .Fragmnttn.Dy.6 0.000 0.000 0.000  
## .Fragmnttn.Dy.7 0.000 0.000 0.000  
## .Fragmnttn.Dy.8 0.000 0.000 0.000  
## .Fragmnttn.Dy.9 0.000 0.000 0.000  
## .Frgmnttn.Dy.10 0.000 0.000 0.000  
## .Frgmnttn.Dy.11 0.000 0.000 0.000  
## .Frgmnttn.Dy.12 0.000 0.000 0.000  
## .Frgmnttn.Dy.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .PA.I 26.543 4.422 6.003 0.000 4.857 4.857  
## .FRAG.I -19.266 6.964 -2.767 0.006 -2.085 -2.085  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 14.225 1.834 7.757 0.000 14.225 0.308  
## .Pcnt.MVPA.Dy.2 10.393 1.375 7.560 0.000 10.393 0.235  
## .Pcnt.MVPA.Dy.3 14.850 1.911 7.772 0.000 14.850 0.288  
## .Pcnt.MVPA.Dy.4 13.194 1.711 7.712 0.000 13.194 0.283  
## .Pcnt.MVPA.Dy.5 11.932 1.559 7.651 0.000 11.932 0.278  
## .Pcnt.MVPA.Dy.6 7.034 0.975 7.217 0.000 7.034 0.177  
## .Pcnt.MVPA.Dy.7 11.028 1.453 7.592 0.000 11.028 0.248  
## .Pcnt.MVPA.Dy.8 13.100 1.700 7.705 0.000 13.100 0.293  
## .Pcnt.MVPA.Dy.9 10.893 1.435 7.592 0.000 10.893 0.246  
## .Pcnt.MVPA.D.10 16.049 2.055 7.810 0.000 16.049 0.309  
## .Pcnt.MVPA.D.11 11.156 1.466 7.609 0.000 11.156 0.269  
## .Pcnt.MVPA.D.12 13.000 1.688 7.701 0.000 13.000 0.281  
## .Pcnt.MVPA.D.13 17.104 2.182 7.839 0.000 17.104 0.364  
## .Fragmnttn.Dy.1 76.527 10.030 7.630 0.000 76.527 0.466  
## .Fragmnttn.Dy.2 128.194 16.258 7.885 0.000 128.194 0.598  
## .Fragmnttn.Dy.3 85.896 11.159 7.697 0.000 85.896 0.491  
## .Fragmnttn.Dy.4 72.703 9.580 7.589 0.000 72.703 0.470  
## .Fragmnttn.Dy.5 85.924 11.168 7.694 0.000 85.924 0.485  
## .Fragmnttn.Dy.6 103.628 13.296 7.794 0.000 103.628 0.527  
## .Fragmnttn.Dy.7 83.216 10.839 7.677 0.000 83.216 0.492  
## .Fragmnttn.Dy.8 92.051 11.903 7.734 0.000 92.051 0.503  
## .Fragmnttn.Dy.9 99.892 12.845 7.776 0.000 99.892 0.524  
## .Frgmnttn.Dy.10 91.955 11.890 7.734 0.000 91.955 0.505  
## .Frgmnttn.Dy.11 72.082 9.505 7.584 0.000 72.082 0.473  
## .Frgmnttn.Dy.12 99.382 12.787 7.772 0.000 99.382 0.536  
## .Frgmnttn.Dy.13 93.347 12.057 7.742 0.000 93.347 0.522  
## .ADAS.Cog.Plus 0.301 0.037 8.244 0.000 0.301 0.697  
## .PA.I 24.978 3.301 7.567 0.000 0.837 0.837  
## .FRAG.I 46.935 6.781 6.921 0.000 0.550 0.550  
##   
## R-Square:  
## Estimate  
## Pcnt.MVPA.Dy.1 0.692  
## Pcnt.MVPA.Dy.2 0.765  
## Pcnt.MVPA.Dy.3 0.712  
## Pcnt.MVPA.Dy.4 0.717  
## Pcnt.MVPA.Dy.5 0.722  
## Pcnt.MVPA.Dy.6 0.823  
## Pcnt.MVPA.Dy.7 0.752  
## Pcnt.MVPA.Dy.8 0.707  
## Pcnt.MVPA.Dy.9 0.754  
## Pcnt.MVPA.D.10 0.691  
## Pcnt.MVPA.D.11 0.731  
## Pcnt.MVPA.D.12 0.719  
## Pcnt.MVPA.D.13 0.636  
## Fragmnttn.Dy.1 0.534  
## Fragmnttn.Dy.2 0.402  
## Fragmnttn.Dy.3 0.509  
## Fragmnttn.Dy.4 0.530  
## Fragmnttn.Dy.5 0.515  
## Fragmnttn.Dy.6 0.473  
## Fragmnttn.Dy.7 0.508  
## Fragmnttn.Dy.8 0.497  
## Fragmnttn.Dy.9 0.476  
## Frgmnttn.Dy.10 0.495  
## Frgmnttn.Dy.11 0.527  
## Frgmnttn.Dy.12 0.464  
## Frgmnttn.Dy.13 0.478  
## ADAS.Cog.Plus 0.303  
## PA.I 0.163  
## FRAG.I 0.450

semPaths(model.sleep.FragAwake.2, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")  
  
  
#~~~~~~~~~~~~~~~~Sleep Efficiency Full Model~~~~~~~~~~~~~~~#  
sleep.EffAwake <- '  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
EFF.I =~ 1\*Efficiency.Day.1 + 1\*Efficiency.Day.2 + 1\*Efficiency.Day.3 + 1\*Efficiency.Day.4 + 1\*Efficiency.Day.5 + 1\*Efficiency.Day.6 + 1\*Efficiency.Day.7 + 1\*Efficiency.Day.8 + 1\*Efficiency.Day.9 + 1\*Efficiency.Day.10 + 1\*Efficiency.Day.11 + 1\*Efficiency.Day.12 + 1\*Efficiency.Day.13  
  
  
#regressions#   
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
EFF.I ~ Age + Sex + Smoking + MED.SLEEP + Avg.Awake  
  
##Correlations between days for latent factors##  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
Efficiency.Day.1 ~ Efficiency.Day.2  
Efficiency.Day.2 ~ Efficiency.Day.3  
Efficiency.Day.3 ~ Efficiency.Day.4  
Efficiency.Day.4 ~ Efficiency.Day.5  
Efficiency.Day.5 ~ Efficiency.Day.6  
Efficiency.Day.6 ~ Efficiency.Day.7  
Efficiency.Day.7 ~ Efficiency.Day.8  
Efficiency.Day.8 ~ Efficiency.Day.9  
Efficiency.Day.9 ~ Efficiency.Day.10  
Efficiency.Day.10 ~ Efficiency.Day.11  
Efficiency.Day.11 ~ Efficiency.Day.12  
Efficiency.Day.12 ~ Efficiency.Day.13  
  
##Relationship of PA and PSQI with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + EFF.I + Age + Sex + Education + Avg.Awake  
  
##Covariation between slopes##  
PA.I ~~ EFF.I  
'  
model.sleep.EffAwake <- growth(sleep.EffAwake, data = PA\_Sleep)  
summary(model.sleep.EffAwake, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 231 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 71  
##   
## Used Total  
## Number of observations 145 146  
##   
## Model Test User Model:  
##   
## Test statistic 875.133  
## Degrees of freedom 496  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 4611.192  
## Degrees of freedom 513  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.907  
## Tucker-Lewis Index (TLI) 0.904  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -11207.487  
## Loglikelihood unrestricted model (H1) -10769.920  
##   
## Akaike (AIC) 22556.973  
## Bayesian (BIC) 22768.321  
## Sample-size adjusted Bayesian (BIC) 22543.652  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.073  
## 90 Percent confidence interval - lower 0.065  
## 90 Percent confidence interval - upper 0.080  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.081  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.932 0.819  
## Pcnt.MVPA.Dy.2 1.000 5.932 0.791  
## Pcnt.MVPA.Dy.3 1.000 5.932 0.737  
## Pcnt.MVPA.Dy.4 1.000 5.932 0.751  
## Pcnt.MVPA.Dy.5 1.000 5.932 0.798  
## Pcnt.MVPA.Dy.6 1.000 5.932 0.843  
## Pcnt.MVPA.Dy.7 1.000 5.932 0.820  
## Pcnt.MVPA.Dy.8 1.000 5.932 0.813  
## Pcnt.MVPA.Dy.9 1.000 5.932 0.822  
## Pcnt.MVPA.D.10 1.000 5.932 0.759  
## Pcnt.MVPA.D.11 1.000 5.932 0.815  
## Pcnt.MVPA.D.12 1.000 5.932 0.810  
## Pcnt.MVPA.D.13 1.000 5.932 0.814  
## EFF.I =~   
## Efficincy.Dy.1 1.000 5.920 0.812  
## Efficincy.Dy.2 1.000 5.920 0.762  
## Efficincy.Dy.3 1.000 5.920 0.687  
## Efficincy.Dy.4 1.000 5.920 0.787  
## Efficincy.Dy.5 1.000 5.920 0.781  
## Efficincy.Dy.6 1.000 5.920 0.823  
## Efficincy.Dy.7 1.000 5.920 0.799  
## Efficincy.Dy.8 1.000 5.920 0.791  
## Efficincy.Dy.9 1.000 5.920 0.796  
## Efficncy.Dy.10 1.000 5.920 0.827  
## Efficncy.Dy.11 1.000 5.920 0.806  
## Efficncy.Dy.12 1.000 5.920 0.785  
## Efficncy.Dy.13 1.000 5.920 0.810  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv  
## PA.I ~   
## Age -0.245 0.066 -3.713 0.000 -0.041  
## Sex -1.801 1.007 -1.788 0.074 -0.304  
## Smoking -0.859 0.893 -0.963 0.336 -0.145  
## MED.SLEEP 0.943 1.397 0.675 0.500 0.159  
## EFF.I ~   
## Age -0.062 0.052 -1.189 0.235 -0.010  
## Sex 1.729 0.829 2.086 0.037 0.292  
## Smoking 1.224 0.704 1.738 0.082 0.207  
## MED.SLEEP -1.935 1.103 -1.754 0.079 -0.327  
## Avg.Awake -0.563 0.052 -10.750 0.000 -0.095  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.039 0.030 1.303 0.193 0.039  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.107 0.027 4.026 0.000 0.107  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.155 0.030 5.169 0.000 0.155  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.138 0.032 4.338 0.000 0.138  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.078 0.031 2.509 0.012 0.078  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.088 0.026 3.366 0.001 0.088  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.072 0.029 2.446 0.014 0.072  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.056 0.031 1.821 0.069 0.056  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.066 0.028 2.359 0.018 0.066  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.107 0.034 3.182 0.001 0.107  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.060 0.031 1.948 0.051 0.060  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.065 0.032 2.042 0.041 0.065  
## Efficiency.Day.1 ~   
## Efficincy.Dy.2 0.006 0.006 0.941 0.347 0.006  
## Efficiency.Day.2 ~   
## Efficincy.Dy.3 -0.002 0.007 -0.287 0.774 -0.002  
## Efficiency.Day.3 ~   
## Efficincy.Dy.4 -0.000 0.008 -0.028 0.977 -0.000  
## Efficiency.Day.4 ~   
## Efficincy.Dy.5 0.006 0.006 0.955 0.340 0.006  
## Efficiency.Day.5 ~   
## Efficincy.Dy.6 -0.003 0.006 -0.410 0.682 -0.003  
## Efficiency.Day.6 ~   
## Efficincy.Dy.7 0.001 0.006 0.223 0.824 0.001  
## Efficiency.Day.7 ~   
## Efficincy.Dy.8 0.001 0.006 0.162 0.872 0.001  
## Efficiency.Day.8 ~   
## Efficincy.Dy.9 0.007 0.006 1.067 0.286 0.007  
## Efficiency.Day.9 ~   
## Efficncy.Dy.10 -0.007 0.006 -1.118 0.263 -0.007  
## Efficiency.Day.10 ~   
## Efficncy.Dy.11 0.001 0.006 0.158 0.874 0.001  
## Efficiency.Day.11 ~   
## Efficncy.Dy.12 0.000 0.006 0.049 0.961 0.000  
## Efficiency.Day.12 ~   
## Efficncy.Dy.13 -0.004 0.006 -0.697 0.486 -0.004  
## ADAS.Cog.Plus ~   
## PA.I -0.016 0.008 -1.915 0.056 -0.095  
## EFF.I -0.008 0.005 -1.510 0.131 -0.046  
## Age 0.014 0.006 2.386 0.017 0.014  
## Sex 0.533 0.106 5.029 0.000 0.533  
## Education -0.162 0.036 -4.537 0.000 -0.162  
## Avg.Awake -0.019 0.006 -3.039 0.002 -0.019  
## Std.all  
##   
## -0.298  
## -0.144  
## -0.076  
## 0.054  
##   
## -0.075  
## 0.138  
## 0.109  
## -0.110  
## -0.698  
##   
## 0.041  
##   
## 0.115  
##   
## 0.152  
##   
## 0.130  
##   
## 0.074  
##   
## 0.090  
##   
## 0.073  
##   
## 0.056  
##   
## 0.071  
##   
## 0.100  
##   
## 0.060  
##   
## 0.065  
##   
## 0.006  
##   
## -0.002  
##   
## -0.000  
##   
## 0.006  
##   
## -0.002  
##   
## 0.001  
##   
## 0.001  
##   
## 0.007  
##   
## -0.007  
##   
## 0.001  
##   
## 0.000  
##   
## -0.004  
##   
## -0.138  
## -0.067  
## 0.149  
## 0.367  
## -0.310  
## -0.206  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PA.I ~~   
## .EFF.I -1.675 2.076 -0.807 0.420 -0.071 -0.071  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .Efficincy.Dy.1 0.000 0.000 0.000  
## .Efficincy.Dy.2 0.000 0.000 0.000  
## .Efficincy.Dy.3 0.000 0.000 0.000  
## .Efficincy.Dy.4 0.000 0.000 0.000  
## .Efficincy.Dy.5 0.000 0.000 0.000  
## .Efficincy.Dy.6 0.000 0.000 0.000  
## .Efficincy.Dy.7 0.000 0.000 0.000  
## .Efficincy.Dy.8 0.000 0.000 0.000  
## .Efficincy.Dy.9 0.000 0.000 0.000  
## .Efficncy.Dy.10 0.000 0.000 0.000  
## .Efficncy.Dy.11 0.000 0.000 0.000  
## .Efficncy.Dy.12 0.000 0.000 0.000  
## .Efficncy.Dy.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .PA.I 27.810 4.759 5.844 0.000 4.688 4.688  
## .EFF.I 101.109 4.045 24.994 0.000 17.079 17.079  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 14.131 1.781 7.935 0.000 14.131 0.269  
## .Pcnt.MVPA.Dy.2 11.412 1.465 7.791 0.000 11.412 0.203  
## .Pcnt.MVPA.Dy.3 15.611 1.956 7.983 0.000 15.611 0.241  
## .Pcnt.MVPA.Dy.4 15.607 1.955 7.985 0.000 15.607 0.250  
## .Pcnt.MVPA.Dy.5 13.712 1.733 7.911 0.000 13.712 0.248  
## .Pcnt.MVPA.Dy.6 7.310 0.990 7.385 0.000 7.310 0.147  
## .Pcnt.MVPA.Dy.7 11.435 1.470 7.781 0.000 11.435 0.219  
## .Pcnt.MVPA.Dy.8 13.576 1.718 7.902 0.000 13.576 0.255  
## .Pcnt.MVPA.Dy.9 11.460 1.471 7.793 0.000 11.460 0.220  
## .Pcnt.MVPA.D.10 17.269 2.150 8.033 0.000 17.269 0.283  
## .Pcnt.MVPA.D.11 13.118 1.664 7.885 0.000 13.118 0.248  
## .Pcnt.MVPA.D.12 13.561 1.716 7.904 0.000 13.561 0.253  
## .Pcnt.MVPA.D.13 17.866 2.220 8.049 0.000 17.866 0.337  
## .Efficincy.Dy.1 17.750 2.271 7.817 0.000 17.750 0.334  
## .Efficincy.Dy.2 25.496 3.175 8.029 0.000 25.496 0.422  
## .Efficincy.Dy.3 39.197 4.780 8.199 0.000 39.197 0.528  
## .Efficincy.Dy.4 21.057 2.656 7.927 0.000 21.057 0.373  
## .Efficincy.Dy.5 22.624 2.839 7.968 0.000 22.624 0.394  
## .Efficincy.Dy.6 16.645 2.142 7.771 0.000 16.645 0.321  
## .Efficincy.Dy.7 19.830 2.513 7.890 0.000 19.830 0.361  
## .Efficincy.Dy.8 20.509 2.592 7.911 0.000 20.509 0.366  
## .Efficincy.Dy.9 20.810 2.628 7.920 0.000 20.810 0.376  
## .Efficncy.Dy.10 16.171 2.087 7.749 0.000 16.171 0.315  
## .Efficncy.Dy.11 18.860 2.400 7.858 0.000 18.860 0.350  
## .Efficncy.Dy.12 22.080 2.776 7.954 0.000 22.080 0.389  
## .Efficncy.Dy.13 18.421 2.349 7.843 0.000 18.421 0.345  
## .ADAS.Cog.Plus 0.321 0.038 8.506 0.000 0.321 0.679  
## .PA.I 30.627 3.925 7.803 0.000 0.870 0.870  
## .EFF.I 18.100 2.317 7.812 0.000 0.516 0.516  
##   
## R-Square:  
## Estimate  
## Pcnt.MVPA.Dy.1 0.731  
## Pcnt.MVPA.Dy.2 0.797  
## Pcnt.MVPA.Dy.3 0.759  
## Pcnt.MVPA.Dy.4 0.750  
## Pcnt.MVPA.Dy.5 0.752  
## Pcnt.MVPA.Dy.6 0.853  
## Pcnt.MVPA.Dy.7 0.781  
## Pcnt.MVPA.Dy.8 0.745  
## Pcnt.MVPA.Dy.9 0.780  
## Pcnt.MVPA.D.10 0.717  
## Pcnt.MVPA.D.11 0.752  
## Pcnt.MVPA.D.12 0.747  
## Pcnt.MVPA.D.13 0.663  
## Efficincy.Dy.1 0.666  
## Efficincy.Dy.2 0.578  
## Efficincy.Dy.3 0.472  
## Efficincy.Dy.4 0.627  
## Efficincy.Dy.5 0.606  
## Efficincy.Dy.6 0.679  
## Efficincy.Dy.7 0.639  
## Efficincy.Dy.8 0.634  
## Efficincy.Dy.9 0.624  
## Efficncy.Dy.10 0.685  
## Efficncy.Dy.11 0.650  
## Efficncy.Dy.12 0.611  
## Efficncy.Dy.13 0.655  
## ADAS.Cog.Plus 0.321  
## PA.I 0.130  
## EFF.I 0.484

semPaths(model.sleep.EffAwake, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")



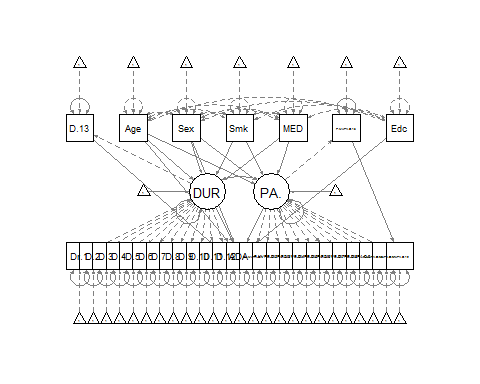
#~~~~~~~~~~~~~~~Sleep Efficiency Outliers Removed~~~~~~~~~~~~~#  
sleep.EffAwake <- '  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
EFF.I =~ 1\*Efficiency.Day.1 + 1\*Efficiency.Day.2 + 1\*Efficiency.Day.3 + 1\*Efficiency.Day.4 + 1\*Efficiency.Day.5 + 1\*Efficiency.Day.6 + 1\*Efficiency.Day.7 + 1\*Efficiency.Day.8 + 1\*Efficiency.Day.9 + 1\*Efficiency.Day.10 + 1\*Efficiency.Day.11 + 1\*Efficiency.Day.12 + 1\*Efficiency.Day.13  
  
  
#regressions#   
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
EFF.I ~ Age + Sex + Smoking + MED.SLEEP + Avg.Awake  
  
##Correlations between days for latent factors##  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
Efficiency.Day.1 ~ Efficiency.Day.2  
Efficiency.Day.2 ~ Efficiency.Day.3  
Efficiency.Day.3 ~ Efficiency.Day.4  
Efficiency.Day.4 ~ Efficiency.Day.5  
Efficiency.Day.5 ~ Efficiency.Day.6  
Efficiency.Day.6 ~ Efficiency.Day.7  
Efficiency.Day.7 ~ Efficiency.Day.8  
Efficiency.Day.8 ~ Efficiency.Day.9  
Efficiency.Day.9 ~ Efficiency.Day.10  
Efficiency.Day.10 ~ Efficiency.Day.11  
Efficiency.Day.11 ~ Efficiency.Day.12  
Efficiency.Day.12 ~ Efficiency.Day.13  
  
##Relationship of PA and PSQI with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + EFF.I + Age + Sex + Education + Avg.Awake  
  
##Covariation between slopes##  
PA.I ~~ EFF.I  
'  
model.sleep.EffAwake <- growth(sleep.EffAwake, data = PA\_Sleep.1)  
summary(model.sleep.EffAwake, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 234 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 71  
##   
## Number of observations 137  
##   
## Model Test User Model:  
##   
## Test statistic 821.841  
## Degrees of freedom 496  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3967.442  
## Degrees of freedom 513  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.906  
## Tucker-Lewis Index (TLI) 0.902  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -10368.427  
## Loglikelihood unrestricted model (H1) -9957.506  
##   
## Akaike (AIC) 20878.853  
## Bayesian (BIC) 21086.172  
## Sample-size adjusted Bayesian (BIC) 20861.559  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.069  
## 90 Percent confidence interval - lower 0.061  
## 90 Percent confidence interval - upper 0.078  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.073  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.465 0.804  
## Pcnt.MVPA.Dy.2 1.000 5.465 0.821  
## Pcnt.MVPA.Dy.3 1.000 5.465 0.760  
## Pcnt.MVPA.Dy.4 1.000 5.465 0.801  
## Pcnt.MVPA.Dy.5 1.000 5.465 0.834  
## Pcnt.MVPA.Dy.6 1.000 5.465 0.865  
## Pcnt.MVPA.Dy.7 1.000 5.465 0.820  
## Pcnt.MVPA.Dy.8 1.000 5.465 0.818  
## Pcnt.MVPA.Dy.9 1.000 5.465 0.821  
## Pcnt.MVPA.D.10 1.000 5.465 0.758  
## Pcnt.MVPA.D.11 1.000 5.465 0.849  
## Pcnt.MVPA.D.12 1.000 5.465 0.804  
## Pcnt.MVPA.D.13 1.000 5.465 0.798  
## EFF.I =~   
## Efficincy.Dy.1 1.000 4.979 0.775  
## Efficincy.Dy.2 1.000 4.979 0.711  
## Efficincy.Dy.3 1.000 4.979 0.766  
## Efficincy.Dy.4 1.000 4.979 0.767  
## Efficincy.Dy.5 1.000 4.979 0.740  
## Efficincy.Dy.6 1.000 4.979 0.775  
## Efficincy.Dy.7 1.000 4.979 0.755  
## Efficincy.Dy.8 1.000 4.979 0.760  
## Efficincy.Dy.9 1.000 4.979 0.751  
## Efficncy.Dy.10 1.000 4.979 0.790  
## Efficncy.Dy.11 1.000 4.979 0.796  
## Efficncy.Dy.12 1.000 4.979 0.737  
## Efficncy.Dy.13 1.000 4.979 0.759  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv  
## PA.I ~   
## Age -0.227 0.061 -3.705 0.000 -0.042  
## Sex -2.181 0.949 -2.298 0.022 -0.399  
## Smoking -0.796 0.830 -0.959 0.337 -0.146  
## MED.SLEEP 2.153 1.336 1.612 0.107 0.394  
## EFF.I ~   
## Age -0.048 0.047 -1.022 0.307 -0.010  
## Sex 1.633 0.760 2.148 0.032 0.328  
## Smoking 1.277 0.646 1.978 0.048 0.256  
## MED.SLEEP -0.547 1.034 -0.529 0.597 -0.110  
## Avg.Awake -0.485 0.053 -9.206 0.000 -0.097  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.032 0.033 0.985 0.325 0.032  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.058 0.028 2.068 0.039 0.058  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.101 0.033 3.057 0.002 0.101  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.056 0.033 1.689 0.091 0.056  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.018 0.032 0.554 0.580 0.018  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.045 0.027 1.673 0.094 0.045  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.056 0.031 1.826 0.068 0.056  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.026 0.032 0.823 0.411 0.026  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.052 0.029 1.796 0.073 0.052  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.094 0.036 2.634 0.008 0.094  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.007 0.030 0.247 0.805 0.007  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.054 0.033 1.637 0.102 0.054  
## Efficiency.Day.1 ~   
## Efficincy.Dy.2 0.005 0.006 0.784 0.433 0.005  
## Efficiency.Day.2 ~   
## Efficincy.Dy.3 -0.003 0.007 -0.467 0.640 -0.003  
## Efficiency.Day.3 ~   
## Efficincy.Dy.4 0.003 0.006 0.574 0.566 0.003  
## Efficiency.Day.4 ~   
## Efficincy.Dy.5 0.007 0.006 1.095 0.274 0.007  
## Efficiency.Day.5 ~   
## Efficincy.Dy.6 0.001 0.006 0.113 0.910 0.001  
## Efficiency.Day.6 ~   
## Efficincy.Dy.7 0.001 0.006 0.175 0.861 0.001  
## Efficiency.Day.7 ~   
## Efficincy.Dy.8 0.002 0.006 0.395 0.693 0.002  
## Efficiency.Day.8 ~   
## Efficincy.Dy.9 0.005 0.006 0.800 0.424 0.005  
## Efficiency.Day.9 ~   
## Efficncy.Dy.10 -0.006 0.006 -0.903 0.367 -0.006  
## Efficiency.Day.10 ~   
## Efficncy.Dy.11 0.003 0.006 0.460 0.646 0.003  
## Efficiency.Day.11 ~   
## Efficncy.Dy.12 0.004 0.006 0.732 0.464 0.004  
## Efficiency.Day.12 ~   
## Efficncy.Dy.13 -0.006 0.006 -0.992 0.321 -0.006  
## ADAS.Cog.Plus ~   
## PA.I -0.017 0.009 -1.870 0.061 -0.092  
## EFF.I -0.011 0.005 -2.010 0.044 -0.054  
## Age 0.015 0.006 2.540 0.011 0.015  
## Sex 0.465 0.107 4.366 0.000 0.465  
## Education -0.146 0.036 -4.028 0.000 -0.146  
## Avg.Awake -0.014 0.007 -2.035 0.042 -0.014  
## Std.all  
##   
## -0.300  
## -0.186  
## -0.077  
## 0.130  
##   
## -0.070  
## 0.153  
## 0.135  
## -0.036  
## -0.645  
##   
## 0.032  
##   
## 0.063  
##   
## 0.096  
##   
## 0.054  
##   
## 0.017  
##   
## 0.048  
##   
## 0.057  
##   
## 0.026  
##   
## 0.056  
##   
## 0.084  
##   
## 0.008  
##   
## 0.054  
##   
## 0.005  
##   
## -0.003  
##   
## 0.003  
##   
## 0.007  
##   
## 0.001  
##   
## 0.001  
##   
## 0.002  
##   
## 0.005  
##   
## -0.005  
##   
## 0.003  
##   
## 0.005  
##   
## -0.006  
##   
## -0.142  
## -0.082  
## 0.170  
## 0.334  
## -0.288  
## -0.142  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .PA.I ~~   
## .EFF.I -2.354 1.725 -1.364 0.172 -0.125 -0.125  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .Efficincy.Dy.1 0.000 0.000 0.000  
## .Efficincy.Dy.2 0.000 0.000 0.000  
## .Efficincy.Dy.3 0.000 0.000 0.000  
## .Efficincy.Dy.4 0.000 0.000 0.000  
## .Efficincy.Dy.5 0.000 0.000 0.000  
## .Efficincy.Dy.6 0.000 0.000 0.000  
## .Efficincy.Dy.7 0.000 0.000 0.000  
## .Efficincy.Dy.8 0.000 0.000 0.000  
## .Efficincy.Dy.9 0.000 0.000 0.000  
## .Efficncy.Dy.10 0.000 0.000 0.000  
## .Efficncy.Dy.11 0.000 0.000 0.000  
## .Efficncy.Dy.12 0.000 0.000 0.000  
## .Efficncy.Dy.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .PA.I 26.477 4.424 5.985 0.000 4.844 4.844  
## .EFF.I 98.208 3.754 26.161 0.000 19.724 19.724  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Pcnt.MVPA.Dy.1 14.221 1.833 7.757 0.000 14.221 0.308  
## .Pcnt.MVPA.Dy.2 10.419 1.378 7.562 0.000 10.419 0.235  
## .Pcnt.MVPA.Dy.3 14.899 1.917 7.773 0.000 14.899 0.288  
## .Pcnt.MVPA.Dy.4 13.140 1.704 7.709 0.000 13.140 0.282  
## .Pcnt.MVPA.Dy.5 11.915 1.558 7.650 0.000 11.915 0.278  
## .Pcnt.MVPA.Dy.6 7.067 0.979 7.221 0.000 7.067 0.177  
## .Pcnt.MVPA.Dy.7 10.984 1.447 7.589 0.000 10.984 0.247  
## .Pcnt.MVPA.Dy.8 13.099 1.700 7.704 0.000 13.099 0.293  
## .Pcnt.MVPA.Dy.9 10.884 1.434 7.591 0.000 10.884 0.246  
## .Pcnt.MVPA.D.10 16.047 2.055 7.809 0.000 16.047 0.309  
## .Pcnt.MVPA.D.11 11.140 1.464 7.608 0.000 11.140 0.269  
## .Pcnt.MVPA.D.12 13.023 1.691 7.702 0.000 13.023 0.282  
## .Pcnt.MVPA.D.13 17.094 2.181 7.838 0.000 17.094 0.364  
## .Efficincy.Dy.1 16.230 2.124 7.639 0.000 16.230 0.393  
## .Efficincy.Dy.2 24.398 3.107 7.853 0.000 24.398 0.498  
## .Efficincy.Dy.3 17.237 2.245 7.677 0.000 17.237 0.408  
## .Efficincy.Dy.4 17.049 2.223 7.670 0.000 17.049 0.404  
## .Efficincy.Dy.5 20.422 2.628 7.770 0.000 20.422 0.451  
## .Efficincy.Dy.6 16.474 2.154 7.649 0.000 16.474 0.399  
## .Efficincy.Dy.7 18.526 2.400 7.718 0.000 18.526 0.426  
## .Efficincy.Dy.8 17.904 2.326 7.699 0.000 17.904 0.417  
## .Efficincy.Dy.9 19.502 2.518 7.746 0.000 19.502 0.443  
## .Efficncy.Dy.10 14.777 1.950 7.576 0.000 14.777 0.372  
## .Efficncy.Dy.11 14.144 1.875 7.545 0.000 14.144 0.361  
## .Efficncy.Dy.12 21.104 2.710 7.787 0.000 21.104 0.463  
## .Efficncy.Dy.13 18.224 2.364 7.709 0.000 18.224 0.424  
## .ADAS.Cog.Plus 0.297 0.036 8.265 0.000 0.297 0.700  
## .PA.I 25.010 3.305 7.568 0.000 0.837 0.837  
## .EFF.I 14.128 1.877 7.525 0.000 0.570 0.570  
##   
## R-Square:  
## Estimate  
## Pcnt.MVPA.Dy.1 0.692  
## Pcnt.MVPA.Dy.2 0.765  
## Pcnt.MVPA.Dy.3 0.712  
## Pcnt.MVPA.Dy.4 0.718  
## Pcnt.MVPA.Dy.5 0.722  
## Pcnt.MVPA.Dy.6 0.823  
## Pcnt.MVPA.Dy.7 0.753  
## Pcnt.MVPA.Dy.8 0.707  
## Pcnt.MVPA.Dy.9 0.754  
## Pcnt.MVPA.D.10 0.691  
## Pcnt.MVPA.D.11 0.731  
## Pcnt.MVPA.D.12 0.718  
## Pcnt.MVPA.D.13 0.636  
## Efficincy.Dy.1 0.607  
## Efficincy.Dy.2 0.502  
## Efficincy.Dy.3 0.592  
## Efficincy.Dy.4 0.596  
## Efficincy.Dy.5 0.549  
## Efficincy.Dy.6 0.601  
## Efficincy.Dy.7 0.574  
## Efficincy.Dy.8 0.583  
## Efficincy.Dy.9 0.557  
## Efficncy.Dy.10 0.628  
## Efficncy.Dy.11 0.639  
## Efficncy.Dy.12 0.537  
## Efficncy.Dy.13 0.576  
## ADAS.Cog.Plus 0.300  
## PA.I 0.163  
## EFF.I 0.430

semPaths(model.sleep.EffAwake, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")  
  
  
  
#~~~~~~~~~~~~~~~~Duration Full Model~~~~~~~~~~~~~~~#  
##Rewrite duration variables  
PA\_Sleep$Duration.1 <- (PA\_Sleep$Duration.Day.1)/60  
PA\_Sleep$Duration.2 <- (PA\_Sleep$Duration.Day.2)/60  
PA\_Sleep$Duration.3 <- (PA\_Sleep$Duration.Day.3)/60  
PA\_Sleep$Duration.4 <- (PA\_Sleep$Duration.Day.4)/60  
PA\_Sleep$Duration.5 <- (PA\_Sleep$Duration.Day.5)/60  
PA\_Sleep$Duration.6 <- (PA\_Sleep$Duration.Day.6)/60  
PA\_Sleep$Duration.7 <- (PA\_Sleep$Duration.Day.7)/60  
PA\_Sleep$Duration.8 <- (PA\_Sleep$Duration.Day.8)/60  
PA\_Sleep$Duration.9 <- (PA\_Sleep$Duration.Day.9)/60  
PA\_Sleep$Duration.10 <- (PA\_Sleep$Duration.Day.10)/60  
PA\_Sleep$Duration.11 <- (PA\_Sleep$Duration.Day.11)/60  
PA\_Sleep$Duration.12 <- (PA\_Sleep$Duration.Day.12)/60  
PA\_Sleep$Duration.13 <- (PA\_Sleep$Duration.Day.13)/60  
PA\_Sleep.1$Duration.1 <- (PA\_Sleep.1$Duration.Day.1)/60  
PA\_Sleep.1$Duration.2 <- (PA\_Sleep.1$Duration.Day.2)/60  
PA\_Sleep.1$Duration.3 <- (PA\_Sleep.1$Duration.Day.3)/60  
PA\_Sleep.1$Duration.4 <- (PA\_Sleep.1$Duration.Day.4)/60  
PA\_Sleep.1$Duration.5 <- (PA\_Sleep.1$Duration.Day.5)/60  
PA\_Sleep.1$Duration.6 <- (PA\_Sleep.1$Duration.Day.6)/60  
PA\_Sleep.1$Duration.7 <- (PA\_Sleep.1$Duration.Day.7)/60  
PA\_Sleep.1$Duration.8 <- (PA\_Sleep.1$Duration.Day.8)/60  
PA\_Sleep.1$Duration.9 <- (PA\_Sleep.1$Duration.Day.9)/60  
PA\_Sleep.1$Duration.10 <- (PA\_Sleep.1$Duration.Day.10)/60   
PA\_Sleep.1$Duration.11 <- (PA\_Sleep.1$Duration.Day.11)/60  
PA\_Sleep.1$Duration.12 <- (PA\_Sleep.1$Duration.Day.12)/60  
PA\_Sleep.1$Duration.13 <- (PA\_Sleep.1$Duration.Day.13)/60  
  
sleep.dur <- '  
DUR.I =~ 1\*Duration.1 + 1\*Duration.2 + 1\*Duration.3 + 1\*Duration.4 + 1\*Duration.5 + 1\*Duration.6 + 1\*Duration.7 + 1\*Duration.8 + 1\*Duration.9 + 1\*Duration.10 + 1\*Duration.11 + 1\*Duration.12 + 1\*Duration.13  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
  
#regressions#   
DUR.I ~ Age + Sex + Smoking + MED.SLEEP  
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
  
##Correlation between days for latent factors##  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
Duration.1 ~ Duration.2  
Duration.2 ~ Duration.3  
Duration.3 ~ Duration.4  
Duration.4 ~ Duration.5  
Duration.5 ~ Duration.6  
Duration.6 ~ Duration.7  
Duration.7 ~ Duration.8  
Duration.8 ~ Duration.9  
Duration.9 ~ Duration.10  
Duration.10 ~ Duration.11  
Duration.11 ~ Duration.12  
Duration.12 ~ Duration.13  
  
##Covariation between slopes##  
DUR.I ~~ PA.I  
  
##Relationship of PA and Duration with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + DUR.I + Age + Sex + Education  
'  
model.sleep.dur <- growth(sleep.dur, data = PA\_Sleep)  
summary(model.sleep.dur, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 156 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 69  
##   
## Number of observations 146  
##   
## Model Test User Model:  
##   
## Test statistic 816.705  
## Degrees of freedom 471  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3883.625  
## Degrees of freedom 486  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.898  
## Tucker-Lewis Index (TLI) 0.895  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -8010.376  
## Loglikelihood unrestricted model (H1) -7602.023  
##   
## Akaike (AIC) 16158.751  
## Bayesian (BIC) 16364.620  
## Sample-size adjusted Bayesian (BIC) 16146.273  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.071  
## 90 Percent confidence interval - lower 0.063  
## 90 Percent confidence interval - upper 0.079  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.067  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## DUR.I =~   
## Duration.1 1.000 0.764 0.694  
## Duration.2 1.000 0.764 0.726  
## Duration.3 1.000 0.764 0.595  
## Duration.4 1.000 0.764 0.740  
## Duration.5 1.000 0.764 0.745  
## Duration.6 1.000 0.764 0.692  
## Duration.7 1.000 0.764 0.705  
## Duration.8 1.000 0.764 0.629  
## Duration.9 1.000 0.764 0.695  
## Duration.10 1.000 0.764 0.589  
## Duration.11 1.000 0.764 0.689  
## Duration.12 1.000 0.764 0.725  
## Duration.13 1.000 0.764 0.713  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.938 0.817  
## Pcnt.MVPA.Dy.2 1.000 5.938 0.793  
## Pcnt.MVPA.Dy.3 1.000 5.938 0.738  
## Pcnt.MVPA.Dy.4 1.000 5.938 0.752  
## Pcnt.MVPA.Dy.5 1.000 5.938 0.799  
## Pcnt.MVPA.Dy.6 1.000 5.938 0.845  
## Pcnt.MVPA.Dy.7 1.000 5.938 0.818  
## Pcnt.MVPA.Dy.8 1.000 5.938 0.813  
## Pcnt.MVPA.Dy.9 1.000 5.938 0.823  
## Pcnt.MVPA.D.10 1.000 5.938 0.761  
## Pcnt.MVPA.D.11 1.000 5.938 0.817  
## Pcnt.MVPA.D.12 1.000 5.938 0.810  
## Pcnt.MVPA.D.13 1.000 5.938 0.816  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## DUR.I ~   
## Age 0.020 0.009 2.178 0.029 0.026 0.187  
## Sex 0.002 0.139 0.016 0.987 0.003 0.001  
## Smoking 0.183 0.123 1.486 0.137 0.240 0.126  
## MED.SLEEP 0.069 0.193 0.360 0.719 0.091 0.031  
## PA.I ~   
## Age -0.251 0.065 -3.828 0.000 -0.042 -0.305  
## Sex -1.835 1.004 -1.828 0.068 -0.309 -0.146  
## Smoking -0.810 0.889 -0.912 0.362 -0.136 -0.072  
## MED.SLEEP 0.901 1.393 0.647 0.518 0.152 0.051  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.042 0.030 1.398 0.162 0.042 0.043  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.106 0.026 3.997 0.000 0.106 0.113  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.153 0.030 5.146 0.000 0.153 0.150  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.138 0.032 4.381 0.000 0.138 0.130  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.078 0.031 2.530 0.011 0.078 0.074  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.085 0.026 3.291 0.001 0.085 0.088  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.075 0.029 2.567 0.010 0.075 0.076  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.057 0.031 1.866 0.062 0.057 0.057  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.066 0.028 2.387 0.017 0.066 0.071  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.105 0.033 3.161 0.002 0.105 0.098  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.058 0.030 1.926 0.054 0.058 0.059  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.067 0.032 2.100 0.036 0.067 0.066  
## Duration.1 ~   
## Duration.2 -0.021 0.013 -1.599 0.110 -0.021 -0.020  
## Duration.2 ~   
## Duration.3 -0.031 0.012 -2.524 0.012 -0.031 -0.038  
## Duration.3 ~   
## Duration.4 -0.009 0.015 -0.614 0.539 -0.009 -0.008  
## Duration.4 ~   
## Duration.5 -0.010 0.012 -0.837 0.403 -0.010 -0.010  
## Duration.5 ~   
## Duration.6 -0.042 0.012 -3.440 0.001 -0.042 -0.045  
## Duration.6 ~   
## Duration.7 -0.017 0.013 -1.295 0.195 -0.017 -0.017  
## Duration.7 ~   
## Duration.8 -0.012 0.012 -0.957 0.338 -0.012 -0.013  
## Duration.8 ~   
## Duration.9 0.005 0.014 0.343 0.731 0.005 0.004  
## Duration.9 ~   
## Duration.10 -0.009 0.013 -0.703 0.482 -0.009 -0.011  
## Duration.10 ~   
## Duration.11 -0.009 0.015 -0.612 0.541 -0.009 -0.008  
## Duration.11 ~   
## Duration.12 -0.017 0.013 -1.326 0.185 -0.017 -0.017  
## Duration.12 ~   
## Duration.13 -0.017 0.012 -1.380 0.168 -0.017 -0.017  
## ADAS.Cog.Plus ~   
## PA.I -0.024 0.008 -2.930 0.003 -0.145 -0.208  
## DUR.I -0.047 0.057 -0.824 0.410 -0.036 -0.051  
## Age 0.005 0.005 0.968 0.333 0.005 0.052  
## Sex 0.449 0.105 4.282 0.000 0.449 0.304  
## Education -0.181 0.035 -5.100 0.000 -0.181 -0.338  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .DUR.I ~~   
## .PA.I 0.175 0.361 0.485 0.628 0.043 0.043  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Duration.1 0.000 0.000 0.000  
## .Duration.2 0.000 0.000 0.000  
## .Duration.3 0.000 0.000 0.000  
## .Duration.4 0.000 0.000 0.000  
## .Duration.5 0.000 0.000 0.000  
## .Duration.6 0.000 0.000 0.000  
## .Duration.7 0.000 0.000 0.000  
## .Duration.8 0.000 0.000 0.000  
## .Duration.9 0.000 0.000 0.000  
## .Duration.10 0.000 0.000 0.000  
## .Duration.11 0.000 0.000 0.000  
## .Duration.12 0.000 0.000 0.000  
## .Duration.13 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .DUR.I 5.280 0.651 8.113 0.000 6.916 6.916  
## .PA.I 28.243 4.722 5.981 0.000 4.757 4.757  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Duration.1 0.651 0.082 7.944 0.000 0.651 0.538  
## .Duration.2 0.557 0.071 7.842 0.000 0.557 0.504  
## .Duration.3 1.076 0.132 8.180 0.000 1.076 0.653  
## .Duration.4 0.494 0.064 7.753 0.000 0.494 0.464  
## .Duration.5 0.513 0.066 7.781 0.000 0.513 0.489  
## .Duration.6 0.654 0.082 7.945 0.000 0.654 0.537  
## .Duration.7 0.602 0.076 7.895 0.000 0.602 0.514  
## .Duration.8 0.886 0.109 8.103 0.000 0.886 0.601  
## .Duration.9 0.633 0.080 7.926 0.000 0.633 0.525  
## .Duration.10 1.107 0.135 8.191 0.000 1.107 0.659  
## .Duration.11 0.664 0.083 7.955 0.000 0.664 0.541  
## .Duration.12 0.547 0.070 7.829 0.000 0.547 0.492  
## .Duration.13 0.565 0.072 7.851 0.000 0.565 0.492  
## .Pcnt.MVPA.Dy.1 14.192 1.781 7.967 0.000 14.192 0.268  
## .Pcnt.MVPA.Dy.2 11.362 1.453 7.817 0.000 11.362 0.203  
## .Pcnt.MVPA.Dy.3 15.519 1.938 8.009 0.000 15.519 0.240  
## .Pcnt.MVPA.Dy.4 15.520 1.937 8.011 0.000 15.520 0.249  
## .Pcnt.MVPA.Dy.5 13.628 1.717 7.937 0.000 13.628 0.247  
## .Pcnt.MVPA.Dy.6 7.317 0.987 7.416 0.000 7.317 0.148  
## .Pcnt.MVPA.Dy.7 11.477 1.469 7.814 0.000 11.477 0.218  
## .Pcnt.MVPA.Dy.8 13.517 1.705 7.929 0.000 13.517 0.254  
## .Pcnt.MVPA.Dy.9 11.389 1.457 7.818 0.000 11.389 0.219  
## .Pcnt.MVPA.D.10 17.158 2.129 8.060 0.000 17.158 0.282  
## .Pcnt.MVPA.D.11 13.033 1.648 7.910 0.000 13.033 0.247  
## .Pcnt.MVPA.D.12 13.507 1.703 7.931 0.000 13.507 0.251  
## .Pcnt.MVPA.D.13 17.755 2.198 8.076 0.000 17.755 0.335  
## .ADAS.Cog.Plus 0.339 0.040 8.527 0.000 0.339 0.698  
## .DUR.I 0.555 0.071 7.764 0.000 0.951 0.951  
## .PA.I 30.505 3.895 7.832 0.000 0.865 0.865  
##   
## R-Square:  
## Estimate  
## Duration.1 0.462  
## Duration.2 0.496  
## Duration.3 0.347  
## Duration.4 0.536  
## Duration.5 0.511  
## Duration.6 0.463  
## Duration.7 0.486  
## Duration.8 0.399  
## Duration.9 0.475  
## Duration.10 0.341  
## Duration.11 0.459  
## Duration.12 0.508  
## Duration.13 0.508  
## Pcnt.MVPA.Dy.1 0.732  
## Pcnt.MVPA.Dy.2 0.797  
## Pcnt.MVPA.Dy.3 0.760  
## Pcnt.MVPA.Dy.4 0.751  
## Pcnt.MVPA.Dy.5 0.753  
## Pcnt.MVPA.Dy.6 0.852  
## Pcnt.MVPA.Dy.7 0.782  
## Pcnt.MVPA.Dy.8 0.746  
## Pcnt.MVPA.Dy.9 0.781  
## Pcnt.MVPA.D.10 0.718  
## Pcnt.MVPA.D.11 0.753  
## Pcnt.MVPA.D.12 0.749  
## Pcnt.MVPA.D.13 0.665  
## ADAS.Cog.Plus 0.302  
## DUR.I 0.049  
## PA.I 0.135

semPaths(model.sleep.dur, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")



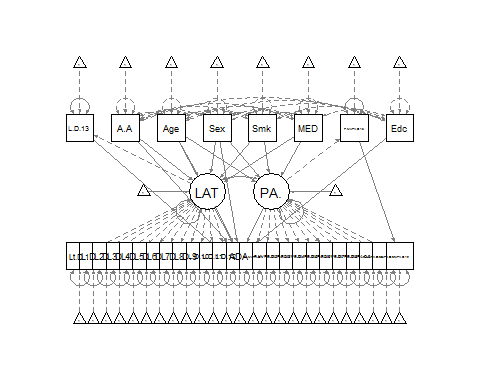
#~~~~~~~~~~~~~~~~~~~Duration Model Outliers Removed~~~~~~~~~~~~~~~~~~~#  
##Rewrite duration variables  
PA\_Sleep$Duration.1 <- (PA\_Sleep$Duration.Day.1)/60  
PA\_Sleep$Duration.2 <- (PA\_Sleep$Duration.Day.2)/60  
PA\_Sleep$Duration.3 <- (PA\_Sleep$Duration.Day.3)/60  
PA\_Sleep$Duration.4 <- (PA\_Sleep$Duration.Day.4)/60  
PA\_Sleep$Duration.5 <- (PA\_Sleep$Duration.Day.5)/60  
PA\_Sleep$Duration.6 <- (PA\_Sleep$Duration.Day.6)/60  
PA\_Sleep$Duration.7 <- (PA\_Sleep$Duration.Day.7)/60  
PA\_Sleep$Duration.8 <- (PA\_Sleep$Duration.Day.8)/60  
PA\_Sleep$Duration.9 <- (PA\_Sleep$Duration.Day.9)/60  
PA\_Sleep$Duration.10 <- (PA\_Sleep$Duration.Day.10)/60  
PA\_Sleep$Duration.11 <- (PA\_Sleep$Duration.Day.11)/60  
PA\_Sleep$Duration.12 <- (PA\_Sleep$Duration.Day.12)/60  
PA\_Sleep$Duration.13 <- (PA\_Sleep$Duration.Day.13)/60  
PA\_Sleep.1$Duration.1 <- (PA\_Sleep.1$Duration.Day.1)/60  
PA\_Sleep.1$Duration.2 <- (PA\_Sleep.1$Duration.Day.2)/60  
PA\_Sleep.1$Duration.3 <- (PA\_Sleep.1$Duration.Day.3)/60  
PA\_Sleep.1$Duration.4 <- (PA\_Sleep.1$Duration.Day.4)/60  
PA\_Sleep.1$Duration.5 <- (PA\_Sleep.1$Duration.Day.5)/60  
PA\_Sleep.1$Duration.6 <- (PA\_Sleep.1$Duration.Day.6)/60  
PA\_Sleep.1$Duration.7 <- (PA\_Sleep.1$Duration.Day.7)/60  
PA\_Sleep.1$Duration.8 <- (PA\_Sleep.1$Duration.Day.8)/60  
PA\_Sleep.1$Duration.9 <- (PA\_Sleep.1$Duration.Day.9)/60  
PA\_Sleep.1$Duration.10 <- (PA\_Sleep.1$Duration.Day.10)/60   
PA\_Sleep.1$Duration.11 <- (PA\_Sleep.1$Duration.Day.11)/60  
PA\_Sleep.1$Duration.12 <- (PA\_Sleep.1$Duration.Day.12)/60  
PA\_Sleep.1$Duration.13 <- (PA\_Sleep.1$Duration.Day.13)/60  
  
sleep.dur <- '  
DUR.I =~ 1\*Duration.1 + 1\*Duration.2 + 1\*Duration.3 + 1\*Duration.4 + 1\*Duration.5 + 1\*Duration.6 + 1\*Duration.7 + 1\*Duration.8 + 1\*Duration.9 + 1\*Duration.10 + 1\*Duration.11 + 1\*Duration.12 + 1\*Duration.13  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
  
#regressions#   
DUR.I ~ Age + Sex + Smoking + MED.SLEEP  
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
  
  
##Correlation between days##  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
Duration.1 ~ Duration.2  
Duration.2 ~ Duration.3  
Duration.3 ~ Duration.4  
Duration.4 ~ Duration.5  
Duration.5 ~ Duration.6  
Duration.6 ~ Duration.7  
Duration.7 ~ Duration.8  
Duration.8 ~ Duration.9  
Duration.9 ~ Duration.10  
Duration.10 ~ Duration.11  
Duration.11 ~ Duration.12  
Duration.12 ~ Duration.13  
  
  
##Covariation between slopes##  
DUR.I ~~ PA.I  
  
##Relationship of PA and Duration with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + DUR.I + Age + Sex + Education   
'  
model.sleep.dur <- growth(sleep.dur, data = PA\_Sleep.1)  
summary(model.sleep.dur, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 153 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 69  
##   
## Number of observations 137  
##   
## Model Test User Model:  
##   
## Test statistic 812.721  
## Degrees of freedom 471  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 3518.013  
## Degrees of freedom 486  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.887  
## Tucker-Lewis Index (TLI) 0.884  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -7378.908  
## Loglikelihood unrestricted model (H1) -6972.547  
##   
## Akaike (AIC) 14895.816  
## Bayesian (BIC) 15097.294  
## Sample-size adjusted Bayesian (BIC) 14879.009  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.073  
## 90 Percent confidence interval - lower 0.064  
## 90 Percent confidence interval - upper 0.081  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.065  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## DUR.I =~   
## Duration.1 1.000 0.757 0.689  
## Duration.2 1.000 0.757 0.728  
## Duration.3 1.000 0.757 0.662  
## Duration.4 1.000 0.757 0.764  
## Duration.5 1.000 0.757 0.741  
## Duration.6 1.000 0.757 0.692  
## Duration.7 1.000 0.757 0.693  
## Duration.8 1.000 0.757 0.630  
## Duration.9 1.000 0.757 0.692  
## Duration.10 1.000 0.757 0.659  
## Duration.11 1.000 0.757 0.688  
## Duration.12 1.000 0.757 0.727  
## Duration.13 1.000 0.757 0.710  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.465 0.804  
## Pcnt.MVPA.Dy.2 1.000 5.465 0.821  
## Pcnt.MVPA.Dy.3 1.000 5.465 0.761  
## Pcnt.MVPA.Dy.4 1.000 5.465 0.801  
## Pcnt.MVPA.Dy.5 1.000 5.465 0.834  
## Pcnt.MVPA.Dy.6 1.000 5.465 0.866  
## Pcnt.MVPA.Dy.7 1.000 5.465 0.819  
## Pcnt.MVPA.Dy.8 1.000 5.465 0.818  
## Pcnt.MVPA.Dy.9 1.000 5.465 0.821  
## Pcnt.MVPA.D.10 1.000 5.465 0.758  
## Pcnt.MVPA.D.11 1.000 5.465 0.848  
## Pcnt.MVPA.D.12 1.000 5.465 0.804  
## Pcnt.MVPA.D.13 1.000 5.465 0.797  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## DUR.I ~   
## Age 0.020 0.009 2.179 0.029 0.026 0.191  
## Sex 0.020 0.142 0.139 0.890 0.026 0.012  
## Smoking 0.201 0.125 1.613 0.107 0.265 0.140  
## MED.SLEEP 0.171 0.201 0.853 0.394 0.226 0.075  
## PA.I ~   
## Age -0.228 0.061 -3.719 0.000 -0.042 -0.301  
## Sex -2.180 0.949 -2.298 0.022 -0.399 -0.186  
## Smoking -0.796 0.829 -0.959 0.337 -0.146 -0.077  
## MED.SLEEP 2.150 1.336 1.610 0.107 0.394 0.130  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.032 0.033 0.980 0.327 0.032 0.032  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.058 0.028 2.066 0.039 0.058 0.063  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.102 0.033 3.063 0.002 0.102 0.096  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.056 0.033 1.687 0.092 0.056 0.054  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.018 0.032 0.550 0.583 0.018 0.017  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.045 0.027 1.677 0.094 0.045 0.048  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.056 0.031 1.825 0.068 0.056 0.057  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.026 0.032 0.823 0.410 0.026 0.026  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.052 0.029 1.794 0.073 0.052 0.056  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.094 0.036 2.634 0.008 0.094 0.084  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.007 0.030 0.245 0.806 0.007 0.008  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.054 0.033 1.637 0.102 0.054 0.054  
## Duration.1 ~   
## Duration.2 -0.025 0.014 -1.785 0.074 -0.025 -0.023  
## Duration.2 ~   
## Duration.3 -0.034 0.013 -2.723 0.006 -0.034 -0.038  
## Duration.3 ~   
## Duration.4 -0.000 0.014 -0.024 0.981 -0.000 -0.000  
## Duration.4 ~   
## Duration.5 -0.015 0.012 -1.195 0.232 -0.015 -0.015  
## Duration.5 ~   
## Duration.6 -0.039 0.013 -3.075 0.002 -0.039 -0.042  
## Duration.6 ~   
## Duration.7 -0.021 0.013 -1.563 0.118 -0.021 -0.021  
## Duration.7 ~   
## Duration.8 -0.014 0.013 -1.100 0.271 -0.014 -0.016  
## Duration.8 ~   
## Duration.9 0.001 0.015 0.061 0.951 0.001 0.001  
## Duration.9 ~   
## Duration.10 -0.009 0.013 -0.721 0.471 -0.009 -0.010  
## Duration.10 ~   
## Duration.11 -0.000 0.014 -0.016 0.987 -0.000 -0.000  
## Duration.11 ~   
## Duration.12 -0.013 0.014 -0.955 0.339 -0.013 -0.012  
## Duration.12 ~   
## Duration.13 -0.021 0.013 -1.632 0.103 -0.021 -0.021  
## ADAS.Cog.Plus ~   
## PA.I -0.024 0.009 -2.683 0.007 -0.131 -0.199  
## DUR.I -0.064 0.057 -1.138 0.255 -0.049 -0.074  
## Age 0.006 0.005 1.254 0.210 0.006 0.071  
## Sex 0.410 0.105 3.888 0.000 0.410 0.289  
## Education -0.171 0.035 -4.817 0.000 -0.171 -0.332  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .DUR.I ~~   
## .PA.I 0.068 0.333 0.205 0.837 0.019 0.019  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Duration.1 0.000 0.000 0.000  
## .Duration.2 0.000 0.000 0.000  
## .Duration.3 0.000 0.000 0.000  
## .Duration.4 0.000 0.000 0.000  
## .Duration.5 0.000 0.000 0.000  
## .Duration.6 0.000 0.000 0.000  
## .Duration.7 0.000 0.000 0.000  
## .Duration.8 0.000 0.000 0.000  
## .Duration.9 0.000 0.000 0.000  
## .Duration.10 0.000 0.000 0.000  
## .Duration.11 0.000 0.000 0.000  
## .Duration.12 0.000 0.000 0.000  
## .Duration.13 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .DUR.I 5.249 0.661 7.937 0.000 6.932 6.932  
## .PA.I 26.532 4.422 6.000 0.000 4.855 4.855  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Duration.1 0.661 0.085 7.736 0.000 0.661 0.547  
## .Duration.2 0.548 0.072 7.623 0.000 0.548 0.506  
## .Duration.3 0.734 0.094 7.789 0.000 0.734 0.562  
## .Duration.4 0.424 0.057 7.432 0.000 0.424 0.432  
## .Duration.5 0.514 0.068 7.579 0.000 0.514 0.492  
## .Duration.6 0.646 0.084 7.722 0.000 0.646 0.540  
## .Duration.7 0.636 0.082 7.713 0.000 0.636 0.533  
## .Duration.8 0.871 0.111 7.866 0.000 0.871 0.603  
## .Duration.9 0.636 0.082 7.714 0.000 0.636 0.531  
## .Duration.10 0.747 0.096 7.798 0.000 0.747 0.566  
## .Duration.11 0.652 0.084 7.728 0.000 0.652 0.538  
## .Duration.12 0.534 0.070 7.606 0.000 0.534 0.493  
## .Duration.13 0.565 0.074 7.643 0.000 0.565 0.496  
## .Pcnt.MVPA.Dy.1 14.231 1.835 7.758 0.000 14.231 0.308  
## .Pcnt.MVPA.Dy.2 10.388 1.374 7.560 0.000 10.388 0.235  
## .Pcnt.MVPA.Dy.3 14.870 1.913 7.773 0.000 14.870 0.288  
## .Pcnt.MVPA.Dy.4 13.182 1.710 7.711 0.000 13.182 0.283  
## .Pcnt.MVPA.Dy.5 11.923 1.558 7.651 0.000 11.923 0.278  
## .Pcnt.MVPA.Dy.6 7.039 0.975 7.218 0.000 7.039 0.177  
## .Pcnt.MVPA.Dy.7 11.007 1.450 7.591 0.000 11.007 0.247  
## .Pcnt.MVPA.Dy.8 13.110 1.701 7.705 0.000 13.110 0.293  
## .Pcnt.MVPA.Dy.9 10.899 1.435 7.592 0.000 10.899 0.246  
## .Pcnt.MVPA.D.10 16.046 2.055 7.810 0.000 16.046 0.309  
## .Pcnt.MVPA.D.11 11.150 1.465 7.608 0.000 11.150 0.269  
## .Pcnt.MVPA.D.12 13.018 1.690 7.702 0.000 13.018 0.282  
## .Pcnt.MVPA.D.13 17.094 2.181 7.838 0.000 17.094 0.364  
## .ADAS.Cog.Plus 0.309 0.037 8.257 0.000 0.309 0.708  
## .DUR.I 0.539 0.071 7.539 0.000 0.939 0.939  
## .PA.I 24.987 3.302 7.568 0.000 0.837 0.837  
##   
## R-Square:  
## Estimate  
## Duration.1 0.453  
## Duration.2 0.494  
## Duration.3 0.438  
## Duration.4 0.568  
## Duration.5 0.508  
## Duration.6 0.460  
## Duration.7 0.467  
## Duration.8 0.397  
## Duration.9 0.469  
## Duration.10 0.434  
## Duration.11 0.462  
## Duration.12 0.507  
## Duration.13 0.504  
## Pcnt.MVPA.Dy.1 0.692  
## Pcnt.MVPA.Dy.2 0.765  
## Pcnt.MVPA.Dy.3 0.712  
## Pcnt.MVPA.Dy.4 0.717  
## Pcnt.MVPA.Dy.5 0.722  
## Pcnt.MVPA.Dy.6 0.823  
## Pcnt.MVPA.Dy.7 0.753  
## Pcnt.MVPA.Dy.8 0.707  
## Pcnt.MVPA.Dy.9 0.754  
## Pcnt.MVPA.D.10 0.691  
## Pcnt.MVPA.D.11 0.731  
## Pcnt.MVPA.D.12 0.718  
## Pcnt.MVPA.D.13 0.636  
## ADAS.Cog.Plus 0.292  
## DUR.I 0.061  
## PA.I 0.163

semPaths(model.sleep.dur, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")  
  
  
#~~~~~~~~~~~~~~~~~~~~Sleep latency Full model~~~~~~~~~~~~~~~~~~~~#  
sleep.lat <- '  
LAT.I =~ 1\*Latency.Day.1 + 1\*Latency.Day.2 + 1\*Latency.Day.3 + 1\*Latency.Day.4 + 1\*Latency.Day.5 + 1\*Latency.Day.6 + 1\*Latency.Day.7 + 1\*Latency.Day.8 + 1\*Latency.Day.9 + 1\*Latency.Day.10 + 1\*Latency.Day.11 + 1\*Latency.Day.12 + 1\*Latency.Day.13  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
  
#regressions#   
LAT.I ~ Age + Sex + Smoking + MED.SLEEP + Avg.Awake  
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
  
##Correlation between days for latent factors##  
Latency.Day.1 ~ Latency.Day.2  
Latency.Day.2 ~ Latency.Day.3  
Latency.Day.3 ~ Latency.Day.4  
Latency.Day.4 ~ Latency.Day.5  
Latency.Day.5 ~ Latency.Day.6  
Latency.Day.6 ~ Latency.Day.7  
Latency.Day.7 ~ Latency.Day.8  
Latency.Day.8 ~ Latency.Day.9  
Latency.Day.9 ~ Latency.Day.10  
Latency.Day.10 ~ Latency.Day.11  
Latency.Day.11 ~ Latency.Day.12  
Latency.Day.12 ~ Latency.Day.13  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
  
  
##Covariation between slopes##  
LAT.I ~~ PA.I  
  
##Relationship of PA and Duration with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + LAT.I + Age + Sex + Education + Avg.Awake  
'  
model.sleep.lat <- growth(sleep.lat, data = PA\_Sleep)  
summary(model.sleep.lat, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 205 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 71  
##   
## Number of observations 146  
##   
## Model Test User Model:  
##   
## Test statistic 1205.681  
## Degrees of freedom 496  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 4005.297  
## Degrees of freedom 513  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.797  
## Tucker-Lewis Index (TLI) 0.790  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -12934.478  
## Loglikelihood unrestricted model (H1) -12331.638  
##   
## Akaike (AIC) 26010.956  
## Bayesian (BIC) 26222.792  
## Sample-size adjusted Bayesian (BIC) 25998.117  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.099  
## 90 Percent confidence interval - lower 0.092  
## 90 Percent confidence interval - upper 0.106  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.091  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## LAT.I =~   
## Latency.Day.1 1.000 6.928 0.523  
## Latency.Day.2 1.000 6.928 0.611  
## Latency.Day.3 1.000 6.928 0.363  
## Latency.Day.4 1.000 6.928 0.458  
## Latency.Day.5 1.000 6.928 0.472  
## Latency.Day.6 1.000 6.928 0.564  
## Latency.Day.7 1.000 6.928 0.405  
## Latency.Day.8 1.000 6.928 0.713  
## Latency.Day.9 1.000 6.928 0.637  
## Latency.Day.10 1.000 6.928 0.506  
## Latency.Day.11 1.000 6.928 0.354  
## Latency.Day.12 1.000 6.928 0.472  
## Latency.Day.13 1.000 6.928 0.537  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.938 0.817  
## Pcnt.MVPA.Dy.2 1.000 5.938 0.793  
## Pcnt.MVPA.Dy.3 1.000 5.938 0.738  
## Pcnt.MVPA.Dy.4 1.000 5.938 0.752  
## Pcnt.MVPA.Dy.5 1.000 5.938 0.799  
## Pcnt.MVPA.Dy.6 1.000 5.938 0.845  
## Pcnt.MVPA.Dy.7 1.000 5.938 0.818  
## Pcnt.MVPA.Dy.8 1.000 5.938 0.814  
## Pcnt.MVPA.Dy.9 1.000 5.938 0.823  
## Pcnt.MVPA.D.10 1.000 5.938 0.761  
## Pcnt.MVPA.D.11 1.000 5.938 0.816  
## Pcnt.MVPA.D.12 1.000 5.938 0.810  
## Pcnt.MVPA.D.13 1.000 5.938 0.815  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## LAT.I ~   
## Age 0.008 0.078 0.108 0.914 0.001 0.009  
## Sex -0.914 1.255 -0.729 0.466 -0.132 -0.062  
## Smoking -0.100 1.064 -0.094 0.925 -0.014 -0.008  
## MED.SLEEP 7.950 1.681 4.728 0.000 1.148 0.386  
## Avg.Awake 0.293 0.079 3.712 0.000 0.042 0.309  
## PA.I ~   
## Age -0.250 0.065 -3.823 0.000 -0.042 -0.305  
## Sex -1.835 1.004 -1.828 0.068 -0.309 -0.146  
## Smoking -0.810 0.889 -0.912 0.362 -0.136 -0.072  
## MED.SLEEP 0.899 1.393 0.645 0.519 0.151 0.051  
## Latency.Day.1 ~   
## Latency.Day.2 -0.058 0.079 -0.737 0.461 -0.058 -0.050  
## Latency.Day.2 ~   
## Latency.Day.3 -0.083 0.041 -2.054 0.040 -0.083 -0.140  
## Latency.Day.3 ~   
## Latency.Day.4 -0.028 0.090 -0.317 0.752 -0.028 -0.022  
## Latency.Day.4 ~   
## Latency.Day.5 0.137 0.066 2.085 0.037 0.137 0.133  
## Latency.Day.5 ~   
## Latency.Day.6 0.209 0.073 2.868 0.004 0.209 0.175  
## Latency.Day.6 ~   
## Latency.Day.7 0.091 0.046 1.996 0.046 0.091 0.127  
## Latency.Day.7 ~   
## Latency.Day.8 0.135 0.120 1.122 0.262 0.135 0.077  
## Latency.Day.8 ~   
## Latency.Day.9 -0.244 0.059 -4.166 0.000 -0.244 -0.273  
## Latency.Day.9 ~   
## Latency.Day.10 0.047 0.047 0.988 0.323 0.047 0.059  
## Latency.Day.10 ~   
## Latency.Day.11 0.135 0.042 3.246 0.001 0.135 0.193  
## Latency.Day.11 ~   
## Latency.Day.12 0.563 0.073 7.695 0.000 0.563 0.421  
## Latency.Day.12 ~   
## Latency.Day.13 0.233 0.070 3.303 0.001 0.233 0.205  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.042 0.030 1.401 0.161 0.042 0.043  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.106 0.026 3.998 0.000 0.106 0.114  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.153 0.030 5.142 0.000 0.153 0.150  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.138 0.032 4.387 0.000 0.138 0.130  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.078 0.031 2.527 0.011 0.078 0.074  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.085 0.026 3.289 0.001 0.085 0.088  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.075 0.029 2.568 0.010 0.075 0.076  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.057 0.031 1.865 0.062 0.057 0.057  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.066 0.028 2.391 0.017 0.066 0.071  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.106 0.033 3.165 0.002 0.106 0.098  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.059 0.030 1.929 0.054 0.059 0.059  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.067 0.032 2.102 0.036 0.067 0.067  
## ADAS.Cog.Plus ~   
## PA.I -0.020 0.008 -2.531 0.011 -0.121 -0.174  
## LAT.I -0.004 0.008 -0.502 0.616 -0.028 -0.040  
## Age 0.006 0.003 2.153 0.031 0.006 0.066  
## Sex 0.528 0.108 4.906 0.000 0.528 0.360  
## Education -0.182 0.034 -5.361 0.000 -0.182 -0.344  
## Avg.Awake -0.016 0.007 -2.401 0.016 -0.016 -0.173  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .LAT.I ~~   
## .PA.I -5.722 3.163 -1.809 0.070 -0.172 -0.172  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Latency.Day.1 0.000 0.000 0.000  
## .Latency.Day.2 0.000 0.000 0.000  
## .Latency.Day.3 0.000 0.000 0.000  
## .Latency.Day.4 0.000 0.000 0.000  
## .Latency.Day.5 0.000 0.000 0.000  
## .Latency.Day.6 0.000 0.000 0.000  
## .Latency.Day.7 0.000 0.000 0.000  
## .Latency.Day.8 0.000 0.000 0.000  
## .Latency.Day.9 0.000 0.000 0.000  
## .Latency.Day.10 0.000 0.000 0.000  
## .Latency.Day.11 0.000 0.000 0.000  
## .Latency.Day.12 0.000 0.000 0.000  
## .Latency.Day.13 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .LAT.I -2.801 6.051 -0.463 0.644 -0.404 -0.404  
## .PA.I 28.223 4.723 5.976 0.000 4.753 4.753  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Latency.Day.1 132.186 16.355 8.082 0.000 132.186 0.753  
## .Latency.Day.2 85.959 11.011 7.807 0.000 85.959 0.668  
## .Latency.Day.3 319.347 38.297 8.339 0.000 319.347 0.877  
## .Latency.Day.4 160.240 19.642 8.158 0.000 160.240 0.701  
## .Latency.Day.5 138.692 17.139 8.092 0.000 138.692 0.644  
## .Latency.Day.6 90.637 11.549 7.848 0.000 90.637 0.602  
## .Latency.Day.7 233.183 28.212 8.265 0.000 233.183 0.797  
## .Latency.Day.8 64.154 8.477 7.568 0.000 64.154 0.679  
## .Latency.Day.9 64.212 8.532 7.526 0.000 64.212 0.544  
## .Latency.Day.10 110.338 13.877 7.951 0.000 110.338 0.589  
## .Latency.Day.11 201.045 24.429 8.230 0.000 201.045 0.524  
## .Latency.Day.12 135.858 16.813 8.081 0.000 135.858 0.631  
## .Latency.Day.13 118.660 14.816 8.009 0.000 118.660 0.712  
## .Pcnt.MVPA.Dy.1 14.178 1.780 7.967 0.000 14.178 0.268  
## .Pcnt.MVPA.Dy.2 11.373 1.455 7.818 0.000 11.373 0.203  
## .Pcnt.MVPA.Dy.3 15.536 1.940 8.010 0.000 15.536 0.240  
## .Pcnt.MVPA.Dy.4 15.496 1.934 8.011 0.000 15.496 0.248  
## .Pcnt.MVPA.Dy.5 13.654 1.720 7.939 0.000 13.654 0.247  
## .Pcnt.MVPA.Dy.6 7.307 0.986 7.415 0.000 7.307 0.148  
## .Pcnt.MVPA.Dy.7 11.445 1.465 7.812 0.000 11.445 0.217  
## .Pcnt.MVPA.Dy.8 13.501 1.703 7.929 0.000 13.501 0.253  
## .Pcnt.MVPA.Dy.9 11.368 1.454 7.817 0.000 11.368 0.218  
## .Pcnt.MVPA.D.10 17.166 2.130 8.060 0.000 17.166 0.282  
## .Pcnt.MVPA.D.11 13.060 1.651 7.912 0.000 13.060 0.247  
## .Pcnt.MVPA.D.12 13.531 1.706 7.932 0.000 13.531 0.252  
## .Pcnt.MVPA.D.13 17.774 2.201 8.077 0.000 17.774 0.335  
## .ADAS.Cog.Plus 0.324 0.038 8.530 0.000 0.324 0.676  
## .LAT.I 36.246 5.769 6.283 0.000 0.755 0.755  
## .PA.I 30.513 3.896 7.832 0.000 0.865 0.865  
##   
## R-Square:  
## Estimate  
## Latency.Day.1 0.247  
## Latency.Day.2 0.332  
## Latency.Day.3 0.123  
## Latency.Day.4 0.299  
## Latency.Day.5 0.356  
## Latency.Day.6 0.398  
## Latency.Day.7 0.203  
## Latency.Day.8 0.321  
## Latency.Day.9 0.456  
## Latency.Day.10 0.411  
## Latency.Day.11 0.476  
## Latency.Day.12 0.369  
## Latency.Day.13 0.288  
## Pcnt.MVPA.Dy.1 0.732  
## Pcnt.MVPA.Dy.2 0.797  
## Pcnt.MVPA.Dy.3 0.760  
## Pcnt.MVPA.Dy.4 0.752  
## Pcnt.MVPA.Dy.5 0.753  
## Pcnt.MVPA.Dy.6 0.852  
## Pcnt.MVPA.Dy.7 0.783  
## Pcnt.MVPA.Dy.8 0.747  
## Pcnt.MVPA.Dy.9 0.782  
## Pcnt.MVPA.D.10 0.718  
## Pcnt.MVPA.D.11 0.753  
## Pcnt.MVPA.D.12 0.748  
## Pcnt.MVPA.D.13 0.665  
## ADAS.Cog.Plus 0.324  
## LAT.I 0.245  
## PA.I 0.135

semPaths(model.sleep.lat, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")



#~~~~~~~~~~~~~~~Sleep latency outliers removed~~~~~~~~~~~~~~~~~#  
sleep.lat <- '  
LAT.I =~ 1\*Latency.Day.1 + 1\*Latency.Day.2 + 1\*Latency.Day.3 + 1\*Latency.Day.4 + 1\*Latency.Day.5 + 1\*Latency.Day.6 + 1\*Latency.Day.7 + 1\*Latency.Day.8 + 1\*Latency.Day.9 + 1\*Latency.Day.10 + 1\*Latency.Day.11 + 1\*Latency.Day.12 + 1\*Latency.Day.13  
PA.I =~ 1\*Pcnt.MVPA.Day.1 + 1\*Pcnt.MVPA.Day.2 + 1\*Pcnt.MVPA.Day.3 + 1\*Pcnt.MVPA.Day.4 + 1\*Pcnt.MVPA.Day.5 + 1\*Pcnt.MVPA.Day.6 + 1\*Pcnt.MVPA.Day.7 + 1\*Pcnt.MVPA.Day.8 + 1\*Pcnt.MVPA.Day.9 + 1\*Pcnt.MVPA.Day.10 + 1\*Pcnt.MVPA.Day.11 + 1\*Pcnt.MVPA.Day.12 + 1\*Pcnt.MVPA.Day.13  
  
#regressions#   
LAT.I ~ Age + Sex + Smoking + MED.SLEEP + Avg.Awake  
PA.I ~ Age + Sex + Smoking + MED.SLEEP  
  
##Correlation between days for latent factors##  
Latency.Day.1 ~ Latency.Day.2  
Latency.Day.2 ~ Latency.Day.3  
Latency.Day.3 ~ Latency.Day.4  
Latency.Day.4 ~ Latency.Day.5  
Latency.Day.5 ~ Latency.Day.6  
Latency.Day.6 ~ Latency.Day.7  
Latency.Day.7 ~ Latency.Day.8  
Latency.Day.8 ~ Latency.Day.9  
Latency.Day.9 ~ Latency.Day.10  
Latency.Day.10 ~ Latency.Day.11  
Latency.Day.11 ~ Latency.Day.12  
Latency.Day.12 ~ Latency.Day.13  
Pcnt.MVPA.Day.1 ~ Pcnt.MVPA.Day.2  
Pcnt.MVPA.Day.2 ~ Pcnt.MVPA.Day.3  
Pcnt.MVPA.Day.3 ~ Pcnt.MVPA.Day.4  
Pcnt.MVPA.Day.4 ~ Pcnt.MVPA.Day.5  
Pcnt.MVPA.Day.5 ~ Pcnt.MVPA.Day.6  
Pcnt.MVPA.Day.6 ~ Pcnt.MVPA.Day.7  
Pcnt.MVPA.Day.7 ~ Pcnt.MVPA.Day.8  
Pcnt.MVPA.Day.8 ~ Pcnt.MVPA.Day.9  
Pcnt.MVPA.Day.9 ~ Pcnt.MVPA.Day.10  
Pcnt.MVPA.Day.10 ~ Pcnt.MVPA.Day.11  
Pcnt.MVPA.Day.11 ~ Pcnt.MVPA.Day.12  
Pcnt.MVPA.Day.12 ~ Pcnt.MVPA.Day.13  
  
  
##Covariation between slopes##  
LAT.I ~~ PA.I  
  
##Relationship of PA and Duration with ADAS-Cog Plus##  
ADAS.Cog.Plus ~ PA.I + LAT.I + Age + Sex + Education + Avg.Awake  
'  
model.sleep.lat <- growth(sleep.lat, data = PA\_Sleep.1)  
summary(model.sleep.lat, fit.measures=TRUE, rsquare=TRUE, std = TRUE)

## lavaan 0.6-5 ended normally after 184 iterations  
##   
## Estimator ML  
## Optimization method NLMINB  
## Number of free parameters 71  
##   
## Number of observations 137  
##   
## Model Test User Model:  
##   
## Test statistic 836.704  
## Degrees of freedom 496  
## P-value (Chi-square) 0.000  
##   
## Model Test Baseline Model:  
##   
## Test statistic 2908.306  
## Degrees of freedom 513  
## P-value 0.000  
##   
## User Model versus Baseline Model:  
##   
## Comparative Fit Index (CFI) 0.858  
## Tucker-Lewis Index (TLI) 0.853  
##   
## Loglikelihood and Information Criteria:  
##   
## Loglikelihood user model (H0) -11538.579  
## Loglikelihood unrestricted model (H1) -11120.227  
##   
## Akaike (AIC) 23219.157  
## Bayesian (BIC) 23426.476  
## Sample-size adjusted Bayesian (BIC) 23201.863  
##   
## Root Mean Square Error of Approximation:  
##   
## RMSEA 0.071  
## 90 Percent confidence interval - lower 0.062  
## 90 Percent confidence interval - upper 0.079  
## P-value RMSEA <= 0.05 0.000  
##   
## Standardized Root Mean Square Residual:  
##   
## SRMR 0.073  
##   
## Parameter Estimates:  
##   
## Information Expected  
## Information saturated (h1) model Structured  
## Standard errors Standard  
##   
## Latent Variables:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## LAT.I =~   
## Latency.Day.1 1.000 3.763 0.313  
## Latency.Day.2 1.000 3.763 0.386  
## Latency.Day.3 1.000 3.763 0.374  
## Latency.Day.4 1.000 3.763 0.539  
## Latency.Day.5 1.000 3.763 0.315  
## Latency.Day.6 1.000 3.763 0.469  
## Latency.Day.7 1.000 3.763 0.413  
## Latency.Day.8 1.000 3.763 0.448  
## Latency.Day.9 1.000 3.763 0.436  
## Latency.Day.10 1.000 3.763 0.424  
## Latency.Day.11 1.000 3.763 0.453  
## Latency.Day.12 1.000 3.763 0.331  
## Latency.Day.13 1.000 3.763 0.350  
## PA.I =~   
## Pcnt.MVPA.Dy.1 1.000 5.465 0.804  
## Pcnt.MVPA.Dy.2 1.000 5.465 0.821  
## Pcnt.MVPA.Dy.3 1.000 5.465 0.761  
## Pcnt.MVPA.Dy.4 1.000 5.465 0.801  
## Pcnt.MVPA.Dy.5 1.000 5.465 0.834  
## Pcnt.MVPA.Dy.6 1.000 5.465 0.866  
## Pcnt.MVPA.Dy.7 1.000 5.465 0.819  
## Pcnt.MVPA.Dy.8 1.000 5.465 0.818  
## Pcnt.MVPA.Dy.9 1.000 5.465 0.821  
## Pcnt.MVPA.D.10 1.000 5.465 0.758  
## Pcnt.MVPA.D.11 1.000 5.465 0.848  
## Pcnt.MVPA.D.12 1.000 5.465 0.804  
## Pcnt.MVPA.D.13 1.000 5.465 0.797  
##   
## Regressions:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## LAT.I ~   
## Age 0.013 0.050 0.255 0.798 0.003 0.025  
## Sex -1.352 0.807 -1.675 0.094 -0.359 -0.168  
## Smoking -0.515 0.684 -0.753 0.452 -0.137 -0.072  
## MED.SLEEP 2.284 1.097 2.082 0.037 0.607 0.200  
## Avg.Awake 0.161 0.056 2.874 0.004 0.043 0.284  
## PA.I ~   
## Age -0.228 0.061 -3.719 0.000 -0.042 -0.301  
## Sex -2.180 0.949 -2.298 0.022 -0.399 -0.186  
## Smoking -0.795 0.829 -0.958 0.338 -0.145 -0.077  
## MED.SLEEP 2.154 1.336 1.612 0.107 0.394 0.130  
## Latency.Day.1 ~   
## Latency.Day.2 -0.031 0.088 -0.358 0.721 -0.031 -0.026  
## Latency.Day.2 ~   
## Latency.Day.3 0.066 0.068 0.973 0.331 0.066 0.068  
## Latency.Day.3 ~   
## Latency.Day.4 0.052 0.095 0.545 0.586 0.052 0.036  
## Latency.Day.4 ~   
## Latency.Day.5 -0.075 0.042 -1.779 0.075 -0.075 -0.129  
## Latency.Day.5 ~   
## Latency.Day.6 -0.054 0.104 -0.518 0.605 -0.054 -0.036  
## Latency.Day.6 ~   
## Latency.Day.7 -0.022 0.061 -0.361 0.718 -0.022 -0.025  
## Latency.Day.7 ~   
## Latency.Day.8 0.025 0.074 0.341 0.733 0.025 0.023  
## Latency.Day.8 ~   
## Latency.Day.9 0.014 0.067 0.210 0.834 0.014 0.014  
## Latency.Day.9 ~   
## Latency.Day.10 -0.037 0.066 -0.556 0.578 -0.037 -0.038  
## Latency.Day.10 ~   
## Latency.Day.11 0.103 0.070 1.469 0.142 0.103 0.097  
## Latency.Day.11 ~   
## Latency.Day.12 0.028 0.052 0.542 0.588 0.028 0.038  
## Latency.Day.12 ~   
## Latency.Day.13 0.085 0.077 1.113 0.266 0.085 0.081  
## Pcnt.MVPA.Day.1 ~   
## Pcnt.MVPA.Dy.2 0.032 0.033 0.979 0.328 0.032 0.031  
## Pcnt.MVPA.Day.2 ~   
## Pcnt.MVPA.Dy.3 0.058 0.028 2.065 0.039 0.058 0.063  
## Pcnt.MVPA.Day.3 ~   
## Pcnt.MVPA.Dy.4 0.102 0.033 3.063 0.002 0.102 0.096  
## Pcnt.MVPA.Day.4 ~   
## Pcnt.MVPA.Dy.5 0.056 0.033 1.686 0.092 0.056 0.054  
## Pcnt.MVPA.Day.5 ~   
## Pcnt.MVPA.Dy.6 0.018 0.032 0.548 0.584 0.018 0.017  
## Pcnt.MVPA.Day.6 ~   
## Pcnt.MVPA.Dy.7 0.045 0.027 1.676 0.094 0.045 0.048  
## Pcnt.MVPA.Day.7 ~   
## Pcnt.MVPA.Dy.8 0.056 0.031 1.825 0.068 0.056 0.057  
## Pcnt.MVPA.Day.8 ~   
## Pcnt.MVPA.Dy.9 0.026 0.032 0.823 0.410 0.026 0.026  
## Pcnt.MVPA.Day.9 ~   
## Pcnt.MVPA.D.10 0.052 0.029 1.794 0.073 0.052 0.056  
## Pcnt.MVPA.Day.10 ~   
## Pcnt.MVPA.D.11 0.094 0.036 2.635 0.008 0.094 0.084  
## Pcnt.MVPA.Day.11 ~   
## Pcnt.MVPA.D.12 0.007 0.030 0.246 0.806 0.007 0.008  
## Pcnt.MVPA.Day.12 ~   
## Pcnt.MVPA.D.13 0.054 0.033 1.636 0.102 0.054 0.054  
## ADAS.Cog.Plus ~   
## PA.I -0.021 0.009 -2.430 0.015 -0.116 -0.177  
## LAT.I 0.019 0.016 1.187 0.235 0.070 0.107  
## Age 0.004 0.003 1.240 0.215 0.004 0.041  
## Sex 0.495 0.111 4.453 0.000 0.495 0.353  
## Education -0.165 0.035 -4.767 0.000 -0.165 -0.323  
## Avg.Awake -0.016 0.007 -2.149 0.032 -0.016 -0.162  
##   
## Covariances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .LAT.I ~~   
## .PA.I -1.990 1.825 -1.091 0.275 -0.114 -0.114  
##   
## Intercepts:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Latency.Day.1 0.000 0.000 0.000  
## .Latency.Day.2 0.000 0.000 0.000  
## .Latency.Day.3 0.000 0.000 0.000  
## .Latency.Day.4 0.000 0.000 0.000  
## .Latency.Day.5 0.000 0.000 0.000  
## .Latency.Day.6 0.000 0.000 0.000  
## .Latency.Day.7 0.000 0.000 0.000  
## .Latency.Day.8 0.000 0.000 0.000  
## .Latency.Day.9 0.000 0.000 0.000  
## .Latency.Day.10 0.000 0.000 0.000  
## .Latency.Day.11 0.000 0.000 0.000  
## .Latency.Day.12 0.000 0.000 0.000  
## .Latency.Day.13 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.1 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.2 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.3 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.4 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.5 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.6 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.7 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.8 0.000 0.000 0.000  
## .Pcnt.MVPA.Dy.9 0.000 0.000 0.000  
## .Pcnt.MVPA.D.10 0.000 0.000 0.000  
## .Pcnt.MVPA.D.11 0.000 0.000 0.000  
## .Pcnt.MVPA.D.12 0.000 0.000 0.000  
## .Pcnt.MVPA.D.13 0.000 0.000 0.000  
## .ADAS.Cog.Plus 0.000 0.000 0.000  
## .LAT.I 0.768 3.958 0.194 0.846 0.204 0.204  
## .PA.I 26.532 4.422 6.000 0.000 4.855 4.855  
##   
## Variances:  
## Estimate Std.Err z-value P(>|z|) Std.lv Std.all  
## .Latency.Day.1 131.184 16.305 8.046 0.000 131.184 0.908  
## .Latency.Day.2 78.309 9.936 7.881 0.000 78.309 0.825  
## .Latency.Day.3 85.303 10.787 7.908 0.000 85.303 0.845  
## .Latency.Day.4 35.725 4.830 7.396 0.000 35.725 0.734  
## .Latency.Day.5 130.111 16.221 8.021 0.000 130.111 0.910  
## .Latency.Day.6 50.703 6.615 7.665 0.000 50.703 0.789  
## .Latency.Day.7 67.926 8.703 7.804 0.000 67.926 0.820  
## .Latency.Day.8 55.856 7.244 7.711 0.000 55.856 0.793  
## .Latency.Day.9 61.195 7.892 7.754 0.000 61.195 0.824  
## .Latency.Day.10 60.951 7.857 7.757 0.000 60.951 0.773  
## .Latency.Day.11 53.924 7.015 7.687 0.000 53.924 0.781  
## .Latency.Day.12 111.432 13.948 7.989 0.000 111.432 0.865  
## .Latency.Day.13 101.178 12.697 7.969 0.000 101.178 0.877  
## .Pcnt.MVPA.Dy.1 14.227 1.834 7.757 0.000 14.227 0.308  
## .Pcnt.MVPA.Dy.2 10.382 1.373 7.559 0.000 10.382 0.234  
## .Pcnt.MVPA.Dy.3 14.863 1.912 7.773 0.000 14.863 0.288  
## .Pcnt.MVPA.Dy.4 13.178 1.709 7.711 0.000 13.178 0.283  
## .Pcnt.MVPA.Dy.5 11.924 1.559 7.651 0.000 11.924 0.278  
## .Pcnt.MVPA.Dy.6 7.027 0.974 7.216 0.000 7.027 0.176  
## .Pcnt.MVPA.Dy.7 11.001 1.449 7.590 0.000 11.001 0.247  
## .Pcnt.MVPA.Dy.8 13.111 1.702 7.705 0.000 13.111 0.293  
## .Pcnt.MVPA.Dy.9 10.905 1.436 7.593 0.000 10.905 0.246  
## .Pcnt.MVPA.D.10 16.050 2.055 7.810 0.000 16.050 0.309  
## .Pcnt.MVPA.D.11 11.165 1.467 7.609 0.000 11.165 0.269  
## .Pcnt.MVPA.D.12 13.032 1.692 7.703 0.000 13.032 0.282  
## .Pcnt.MVPA.D.13 17.097 2.181 7.839 0.000 17.097 0.364  
## .ADAS.Cog.Plus 0.301 0.037 8.216 0.000 0.301 0.703  
## .LAT.I 12.181 2.288 5.324 0.000 0.860 0.860  
## .PA.I 24.987 3.302 7.568 0.000 0.837 0.837  
##   
## R-Square:  
## Estimate  
## Latency.Day.1 0.092  
## Latency.Day.2 0.175  
## Latency.Day.3 0.155  
## Latency.Day.4 0.266  
## Latency.Day.5 0.090  
## Latency.Day.6 0.211  
## Latency.Day.7 0.180  
## Latency.Day.8 0.207  
## Latency.Day.9 0.176  
## Latency.Day.10 0.227  
## Latency.Day.11 0.219  
## Latency.Day.12 0.135  
## Latency.Day.13 0.123  
## Pcnt.MVPA.Dy.1 0.692  
## Pcnt.MVPA.Dy.2 0.766  
## Pcnt.MVPA.Dy.3 0.712  
## Pcnt.MVPA.Dy.4 0.717  
## Pcnt.MVPA.Dy.5 0.722  
## Pcnt.MVPA.Dy.6 0.824  
## Pcnt.MVPA.Dy.7 0.753  
## Pcnt.MVPA.Dy.8 0.707  
## Pcnt.MVPA.Dy.9 0.754  
## Pcnt.MVPA.D.10 0.691  
## Pcnt.MVPA.D.11 0.731  
## Pcnt.MVPA.D.12 0.718  
## Pcnt.MVPA.D.13 0.636  
## ADAS.Cog.Plus 0.297  
## LAT.I 0.140  
## PA.I 0.163

semPaths(model.sleep.lat, "col", sizeMan = 6, edge.label.cex = .5, layout = "tree")