Objective 1 Longitudinal Analysis

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2025-03-02

note to self: run regression diagnostics and ignore clustering - regular linear regression and see if any observations are having huge impact change days to months

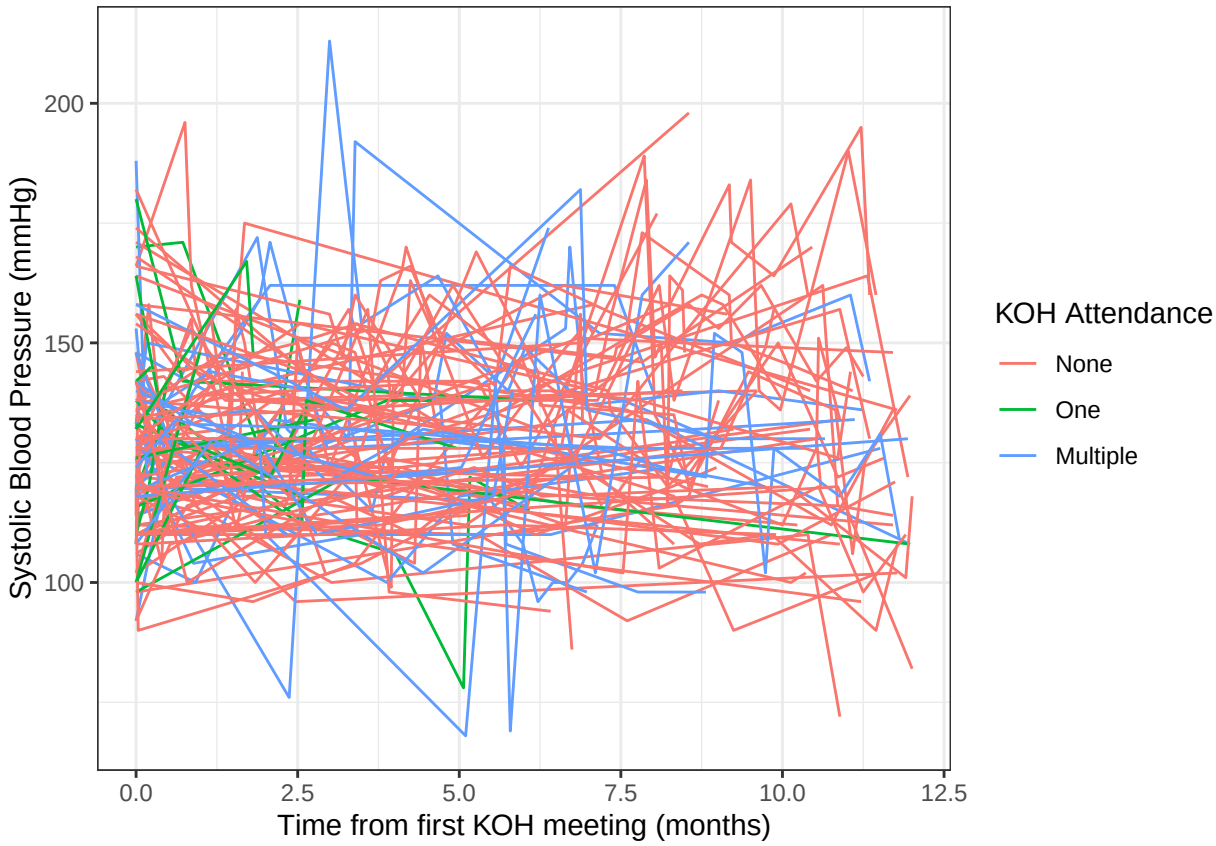
83 none; 14 one; 23 multiple; 120 total

```
bp <- read.csv('Analysis Data/Obj1BP_LME.csv')[,-1]
```

```
# standardizing time as days from baseline measurement
bp.first <- bp %>% group_by(UniqueIdentifier) %>% arrange(BPDate, .by_group=TRUE) %>% slice_head()
bp.first$BPDate <- bp.first$KOH.start.dt
bp <- bp %>% filter(BPDate>KOH.start.dt)

bp <- rbind(bp.first, bp) %>% arrange(UniqueIdentifier, BPDate)
bp <- bp %>% mutate(time.from.koh1 = round(as.numeric(difftime(BPDate, KOH.start.dt, units="days"))))
bp <- bp %>% mutate(koh.cat = case_when(KOH.none == 1 ~ 'None',
                                        KOH.one == 1 ~ 'One',
                                        KOH.mult == 1 ~ 'Multiple'))
bp$koh.cat <- factor(bp$koh.cat, levels=c("None","One","Multiple"))
bp$male <- ifelse(bp$Sex == 'M', 1, 0)
bp$month.exact <- bp$time.from.koh1 / 30.4

ggplot(data= bp,
       aes(x=month.exact, y=Systolic, group=UniqueIdentifier, colour=koh.cat))+
  geom_line() +
  xlab("Time from first KOH meeting (months)") + ylab("Systolic Blood Pressure (mmHg)") + theme_bw() +
  guides(colour = guide_legend(title = "KOH Attendance"))
```

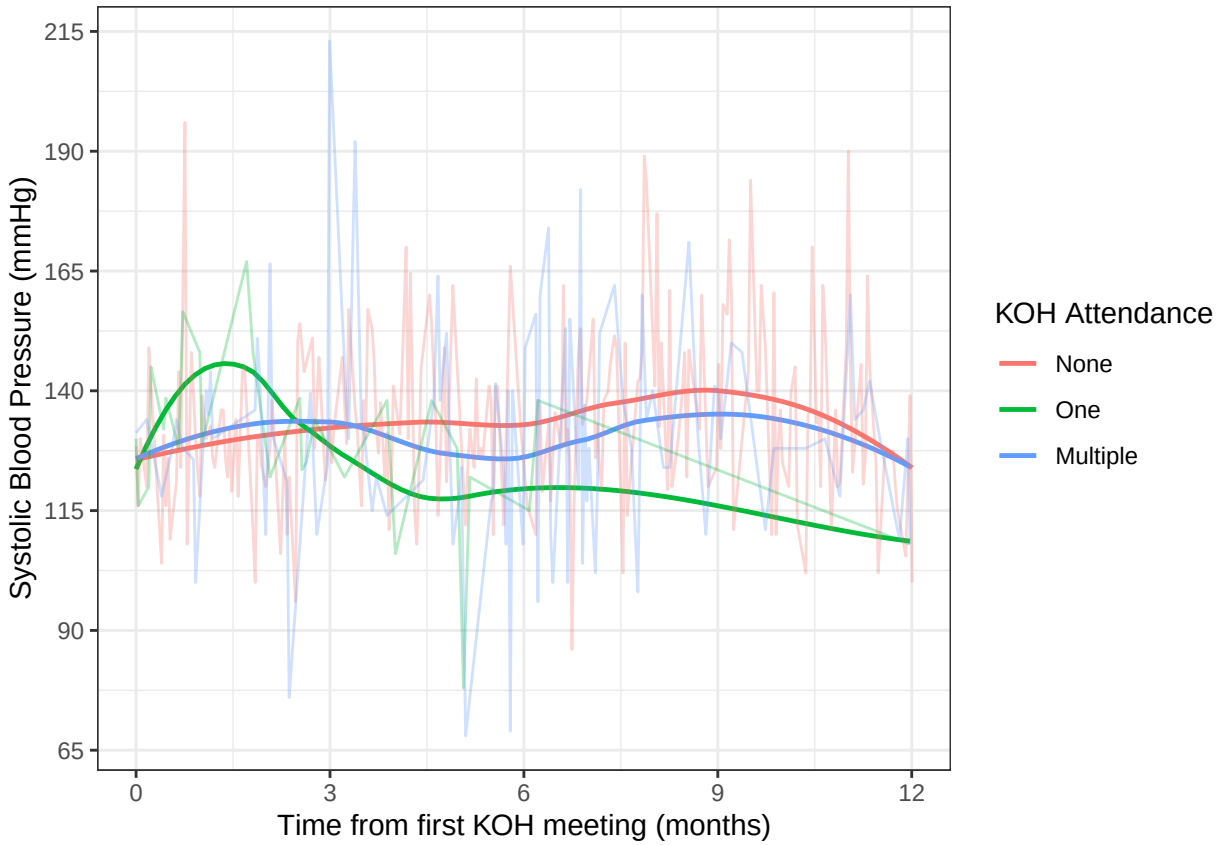



```
summary_bp <- bp %>% group_by(koh.cat, month.exact) %>%
  summarise(mean_bp = mean(Systolic))
```

```
## `summarise()` has grouped output by 'koh.cat'. You can override using the
## `.groups` argument.
```

```
ggplot(data=summary_bp,
       aes(x=month.exact, y=mean_bp, group=koh.cat, colour=koh.cat))+
   geom_smooth(method=loess, se=FALSE, linewidth=0.85) + geom_line(alpha=0.3) +
  xlab("Time from first KOH meeting (months)") + ylab("Systolic Blood Pressure (mmHg)") + theme_bw() +
  guides(colour = guide_legend(title = "KOH Attendance")) + scale_x_continuous(breaks=seq(0,12, by=3)) +
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



need to take out first bps for patients who don't have measurements within 1 year taking out patients that don't have a post measurement within 1 year removes 7 patients: 6 none and 1 multiple. now there are 120 analyzable patients by month: time x one: -1.45299597 (-3.81075425, 0.90476231) (p=0.23); time x multiple: -0.47911912 (-1.43399301,0.47575476) (p=0.32) one: 4.62355706 (-4.44647627, 13.69359039) (p=0.31); multiple: 2.44347920 (-4.79223538, 9.67919377) (p=0.50) time: 0.32698574 (-0.12857395, 0.78254542) (p=0.16)

For 1 year: time x one: -17.43595 (-45.66484, 10.79293); time x multiple: -5.749429 (-17.18191, 5.683051) one: 55.48268 (-52.18372, 163.1491); multiple: 29.32175 (-56.57026, 115.2138) time: 3.923829 (-1.53048, 9.378138)

```
bp.mod1 <- lme(
  fixed = Systolic ~ month.exact * koh.cat + age + male + IncomeLevel + BLACERISK + avg.bmi,
  random = ~ month.exact | UniqueIdentifier,
  data = bp,
  method = "REML"
)
summary(bp.mod1)
```

```
## Linear mixed-effects model fit by REML
##   Data: bp
##        AIC     BIC    logLik
##   5658.264 5725.21 -2814.132
##
## Random effects:
##  Formula: ~month.exact | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##              StdDev     Corr
## (Intercept) 10.0905394 (Intr)
## month.exact  0.6312216 0.751
```

```
## Residual    16.2485858
##
## Fixed effects:  Systolic ~ month.exact * koh.cat + age + male + IncomeLevel +      BLACERISK + avg.bm
##                                 Value Std.Error  DF   t-value p-value
## (Intercept)                112.49273 12.912296 529  8.712062  0.0000
## month.exact                  0.32699  0.231901 529  1.410024  0.1591
## koh.catOne                   4.62356  4.577653 112  1.010028  0.3147
## koh.catMultiple              2.44348  3.651871 112  0.669103  0.5048
## age                          0.06575  0.138339 112  0.475304  0.6355
## male                         3.71967  2.736728 112  1.359167  0.1768
## IncomeLevel                 -0.01148  0.021377 112 -0.537152  0.5922
## BLACERISK                   -0.83370  0.627518 112 -1.328571  0.1867
## avg.bmi                      0.44618  0.259648 112  1.718413  0.0885
## month.exact:koh.catOne      -1.45300  1.200208 529 -1.210620  0.2266
## month.exact:koh.catMultiple -0.47912  0.486075 529 -0.985690  0.3247
##  Correlation:
##                             (Intr) mnth.x kh.ctO kh.ctM age    male   IncmLv
## month.exact                 -0.024
## koh.catOne                   0.004  0.139
## koh.catMultiple              0.067  0.172  0.196
## age                         -0.760 -0.020 -0.100 -0.215
## male                        -0.084  0.009  0.001 -0.020  0.030
## IncomeLevel                 -0.242  0.009  0.131 -0.066  0.385 -0.191
## BLACERISK                   -0.107 -0.008  0.018 -0.074 -0.141 -0.198 -0.054
## avg.bmi                     -0.746 -0.019 -0.006  0.043  0.185  0.031 -0.110
## month.exact:koh.catOne       0.024 -0.193 -0.361 -0.023 -0.021  0.004 -0.018
## month.exact:koh.catMultiple  0.007 -0.477 -0.067 -0.356  0.007 -0.001 -0.014
##                             BLACER avg.bm mn.:.O
## month.exact
## koh.catOne
## koh.catMultiple
## age
## male
## IncomeLevel
## BLACERISK
## avg.bmi                      0.129
## month.exact:koh.catOne      -0.027  0.005
## month.exact:koh.catMultiple  0.017  0.016  0.092
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -4.31456673 -0.53900589 -0.05014198  0.46323566  4.09081444
##
## Number of Observations: 652
## Number of Groups: 120
```

```
intervals(bp.mod1)
```

```
## Approximate 95% confidence intervals
##
##  Fixed effects:
##                                   lower         est.        upper
## (Intercept)                87.12705700 112.49272627 137.85839555
## month.exact                -0.12857395   0.32698574   0.78254542
## koh.catOne                 -4.44647627   4.62355706  13.69359039
```

```
## koh.catMultiple             -4.79223538   2.44347920   9.67919377
## age                         -0.20834793   0.06575304   0.33985401
## male                        -1.70280543   3.71967037   9.14214617
## IncomeLevel                 -0.05383772  -0.01148253   0.03087266
## BLACERISK                   -2.07704761  -0.83370167   0.40964427
## avg.bmi                     -0.06827669   0.44618200   0.96064069
## month.exact:koh.catOne      -3.81075425  -1.45299597   0.90476231
## month.exact:koh.catMultiple -1.43399301  -0.47911912   0.47575476
##
##  Random Effects:
##   Level: UniqueIdentifier
##                                    lower       est.      upper
## sd((Intercept))                7.5444812 10.0905394 13.4958232
## sd(month.exact)                0.1136166  0.6312216  3.5068897
## cor((Intercept),month.exact) -0.9995622  0.7512132  0.9999912
##
##  Within-group standard error:
##    lower     est.    upper
## 15.21118 16.24859 17.35674
```

```
fixed_effects <- summary(bp.mod1)$tTable

# Get estimate and SE for month.from.koh1
month_effect <- fixed_effects["month.exact", "Value"]
month_se <- fixed_effects["month.exact", "Std.Error"]

# Compute 12-month estimate and 95% CI
estimate_12m <- 12 * month_effect
se_12m <- 12 * month_se
ci_lower <- estimate_12m - 1.96 * se_12m
ci_upper <- estimate_12m + 1.96 * se_12m

# Display results
cat("12-month estimate:", estimate_12m, "\n")
```

```
## 12-month estimate: 3.923829
```

```
cat("95% CI: (", ci_lower, ",", ci_upper, ")\n")
```

```
## 95% CI: ( -1.53048 , 9.378138 )
```

```
month_effect <- fixed_effects["koh.catOne", "Value"]
month_se <- fixed_effects["koh.catOne", "Std.Error"]

month_effect <- fixed_effects["koh.catMultiple", "Value"]
month_se <- fixed_effects["koh.catMultiple", "Std.Error"]

month_effect <- fixed_effects["month.exact:koh.catOne", "Value"]
month_se <- fixed_effects["month.exact:koh.catOne", "Std.Error"]

month_effect <- fixed_effects["month.exact:koh.catMultiple", "Value"]
month_se <- fixed_effects["month.exact:koh.catMultiple", "Std.Error"]
```

136 none; 27 one; 34 multiple; 197 total

```
a1c <- read.csv('Analysis Data/Obj1A1c_LME.csv')[,-1]
length(unique(a1c$UniqueIdentifier))
```

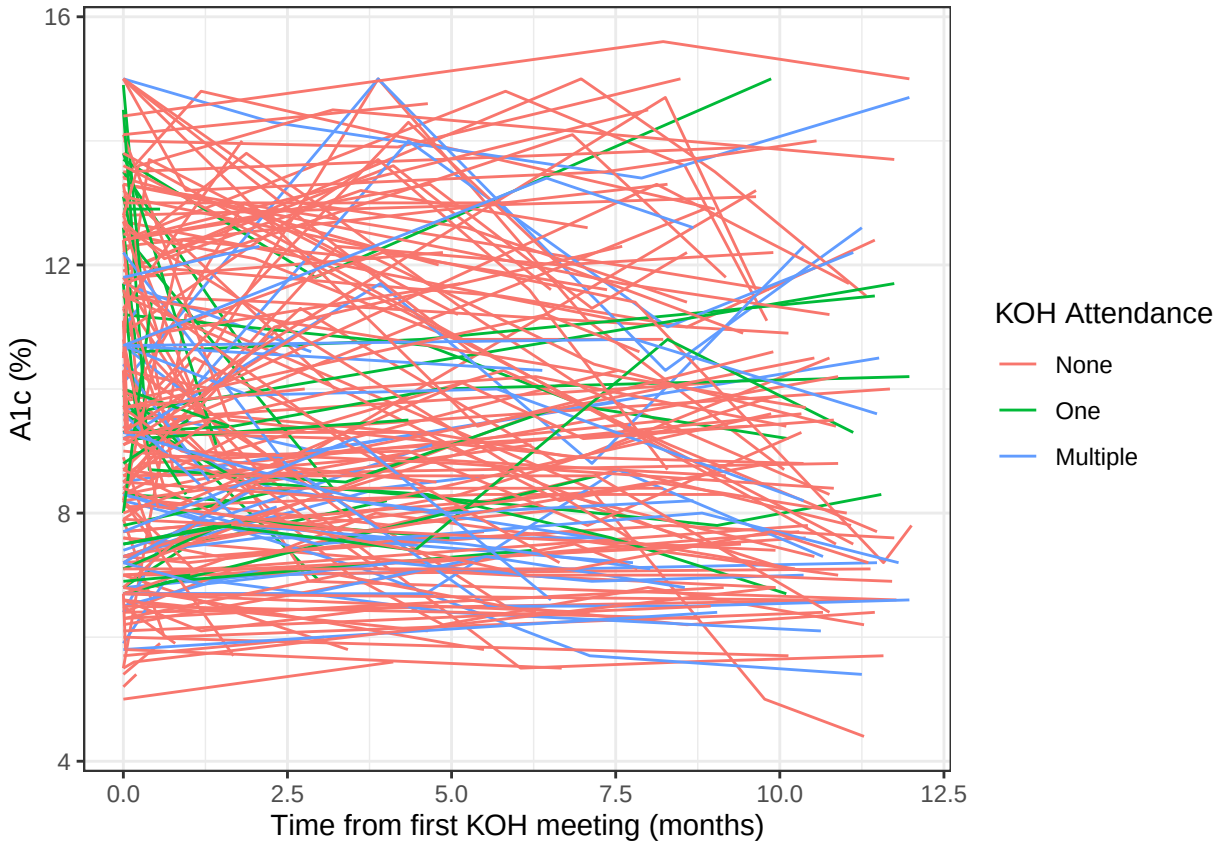
```
## [1] 197
```

removed 21 none, 1 one, and 2 multiple. now there are 197 analyzable patients

```
# standardizing time as days from baseline measurement
a1c.first <- a1c %>% group_by(UniqueIdentifier) %>% arrange(A1cDate, .by_group=TRUE) %>% slice_head()
a1c.first$A1cDate <- a1c.first$KOH.start.dt
a1c <- a1c %>% filter(A1cDate>KOH.start.dt)

a1c <- rbind(a1c.first, a1c) %>% arrange(UniqueIdentifier, A1cDate)
a1c <- a1c %>% mutate(time.from.koh1 = round(as.numeric(difftime(A1cDate, KOH.start.dt, units="days"))))
a1c <- a1c %>% mutate(koh.cat = case_when(KOH.none == 1 ~ 'None',
                                          KOH.one == 1 ~ 'One',
                                          KOH.mult == 1 ~ 'Multiple'))
a1c$koh.cat <- factor(a1c$koh.cat, levels=c("None","One","Multiple"))
a1c$male <- ifelse(a1c$Sex == 'M', 1, 0)
a1c$month.exact <- a1c$time.from.koh1 / 30.4

ggplot(data= a1c,
       aes(x=month.exact, y=A1c, group=UniqueIdentifier, colour=koh.cat))+
  geom_line() +
  xlab("Time from first KOH meeting (months)") + ylab("A1c (%)") + theme_bw() +
  guides(colour = guide_legend(title = "KOH Attendance"))
```

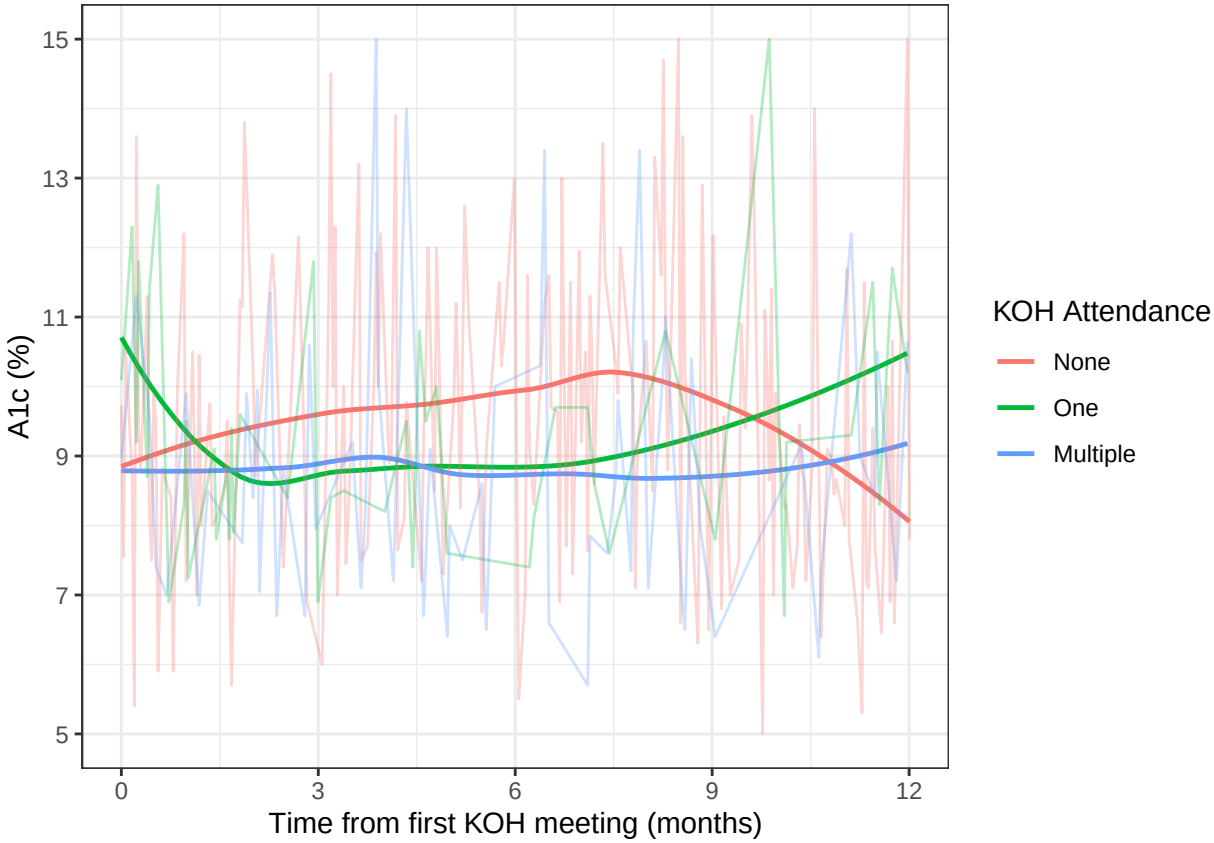


```
summary_a1c <- a1c %>% group_by(koh.cat, month.exact) %>%
  summarise(mean_a1c = mean(A1c))
```

```
## `summarise()` has grouped output by 'koh.cat'. You can override using the
## `.groups` argument.
```

```
ggplot(data=summary_a1c,
       aes(x=month.exact, y=mean_a1c, group=koh.cat, colour=koh.cat))+
   geom_smooth(method=loess, se=FALSE, linewidth=0.85) + geom_line(alpha=0.3) +
  xlab("Time from first KOH meeting (months)") + ylab("A1c (%)") + theme_bw() +
  guides(colour = guide_legend(title = "KOH Attendance")) + scale_x_continuous(breaks=seq(0,12, by=3)) +
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



by month: time x one: -0.006648114 (-0.131476290, 0.118180063) (p=0.92); time x multiple: 0.023027198 (-0.070412100, 0.116466496) (p=0.63) one: 0.104844918 (-0.901726576, 1.111416412) (p=0.84); multiple: -0.410681954 (-1.319098984, 0.497735076) (p=0.37) time: -0.044443149 (-0.085665571, -0.003220728) (p=0.03)

For 1 year: time x one: -0.07977737 (-1.573278, 1.413723); time x multiple: 0.2763264 (-0.8416232,1.394276) one: 1.258139 (-10.7436, 13.25987); multiple: -4.928183 (-15.75958, 5.903218) time: -0.5333178 (-1.026521, -0.0401143)

```
a1c.mod1 <- lme(
  fixed = A1c ~ month.exact * koh.cat + age + male + IncomeLevel + BLACERISK + avg.bmi,
  random = ~ month.exact | UniqueIdentifier,
  data = a1c,
  method = "REML"
)
intervals(a1c.mod1)
```

```
## Approximate 95% confidence intervals
##
##  Fixed effects:
##                                     lower         est.        upper
## (Intercept)                 11.931310462 14.604931394 17.278552325
## month.exact                 -0.085665571 -0.044443149 -0.003220728
## koh.catOne                  -0.901726576  0.104844918  1.111416412
## koh.catMultiple             -1.319098984 -0.410681954  0.497735076
## age                         -0.078775710 -0.048825813 -0.018875916
## male                        -0.719373310 -0.076951996  0.565469319
## IncomeLevel                 -0.002812489  0.001618856  0.006050202
## BLACERISK                   -0.208430916 -0.046648333  0.115134249
## avg.bmi                     -0.127447174 -0.069869784 -0.012292393
## month.exact:koh.catOne      -0.131476290 -0.006648114  0.118180063
## month.exact:koh.catMultiple -0.070412100  0.023027198  0.116466496
##
##  Random Effects:
##   Level: UniqueIdentifier
##                                    lower       est.       upper
## sd((Intercept))                 1.8795932  2.1323970  2.41920264
## sd(month.exact)                 0.1099428  0.1449825  0.19118945
## cor((Intercept),month.exact) -0.5294890 -0.3025157 -0.03512354
##
##  Within-group standard error:
##    lower     est.    upper
## 1.126220 1.224618 1.331612
```

```
summary(a1c.mod1)
```

```
## Linear mixed-effects model fit by REML
##   Data: a1c
##        AIC      BIC    logLik
##   2546.755 2612.584 -1258.378
##
## Random effects:
##  Formula: ~month.exact | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev    Corr
## (Intercept) 2.1323970 (Intr)
## month.exact 0.1449825 -0.303
## Residual    1.2246176
##
## Fixed effects:  A1c ~ month.exact * koh.cat + age + male + IncomeLevel + BLACERISK +      avg.bmi
##                                   Value Std.Error  DF   t-value p-value
## (Intercept)                  14.604931 1.3600509 406 10.738518  0.0000
## month.exact                  -0.044443 0.0209695 406 -2.119415  0.0347
## koh.catOne                    0.104845 0.5102778 189  0.205466  0.8374
## koh.catMultiple              -0.410682 0.4605188 189 -0.891781  0.3736
## age                          -0.048826 0.0151830 189 -3.215823  0.0015
## male                         -0.076952 0.3256732 189 -0.236286  0.8135
## IncomeLevel                   0.001619 0.0022465 189  0.720627  0.4720
## BLACERISK                    -0.046648 0.0820151 189 -0.568777  0.5702
## avg.bmi                      -0.069870 0.0291887 189 -2.393731  0.0177
## month.exact:koh.catOne       -0.006648 0.0634992 406 -0.104696  0.9167
## month.exact:koh.catMultiple   0.023027 0.0475319 406  0.484458  0.6283
```

```
##  Correlation:
##                               (Intr) mnth.x kh.ctO kh.ctM age    male   IncmLv
## month.exact                   -0.053
## koh.catOne                    -0.041  0.162
## koh.catMultiple                0.088  0.178  0.203
## age                           -0.712 -0.013 -0.188 -0.179
## male                          -0.066  0.002  0.003  0.038  0.013
## IncomeLevel                   -0.288 -0.014 -0.020 -0.052  0.313 -0.176
## BLACERISK                     -0.089 -0.003  0.127  0.003 -0.181 -0.130 -0.035
## avg.bmi                       -0.748  0.005  0.121 -0.064  0.137  0.000  0.015
## month.exact:koh.catOne         0.012 -0.330 -0.326 -0.061  0.013  0.005 -0.012
## month.exact:koh.catMultiple    0.023 -0.441 -0.069 -0.388  0.000 -0.002  0.007
##                               BLACER avg.bm mn.:.O
## month.exact
## koh.catOne
## koh.catMultiple
## age
## male
## IncomeLevel
## BLACERISK
## avg.bmi                        0.079
## month.exact:koh.catOne         0.006 -0.001
## month.exact:koh.catMultiple    0.009  0.003  0.146
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -2.23478327 -0.44344093 -0.08248667  0.34619302  3.48063335
##
## Number of Observations: 606
## Number of Groups: 197
```

```r
fixed_effects <- summary(a1c.mod1)$tTable

# Get estimate and SE for month.from.koh1
month_effect <- fixed_effects["month.exact", "Value"]
month_se <- fixed_effects["month.exact", "Std.Error"]

# Compute 12-month estimate and 95% CI
estimate_12m <- 12 * month_effect
se_12m <- 12 * month_se
ci_lower <- estimate_12m - 1.96 * se_12m
ci_upper <- estimate_12m + 1.96 * se_12m

# Display results
cat("12-month estimate:", estimate_12m, "\n")
```

```
## 12-month estimate: -0.5333178
```

```r
cat("95% CI: (",ci_lower,",", ci_upper,")\n")
```

```
## 95% CI: ( -1.026521 , -0.0401143 )
```

```r
month_effect <- fixed_effects["koh.catOne", "Value"]
month_se <- fixed_effects["koh.catOne", "Std.Error"]

month_effect <- fixed_effects["koh.catMultiple", "Value"]
```

```
month_se <- fixed_effects["koh.catMultiple", "Std.Error"]

month_effect <- fixed_effects["month.exact:koh.catOne", "Value"]
month_se <- fixed_effects["month.exact:koh.catOne", "Std.Error"]

month_effect <- fixed_effects["month.exact:koh.catMultiple", "Value"]
month_se <- fixed_effects["month.exact:koh.catMultiple", "Std.Error"]
```

secondary objective 126 marsh; 4695 NHW; 4821 total

```
bp2 <- read.csv('Analysis Data/Obj2BP_LME.csv')[,-1]
length(unique(bp2$UniqueIdentifier[bp2$Marsh==1]))
```

```
## [1] 126
```

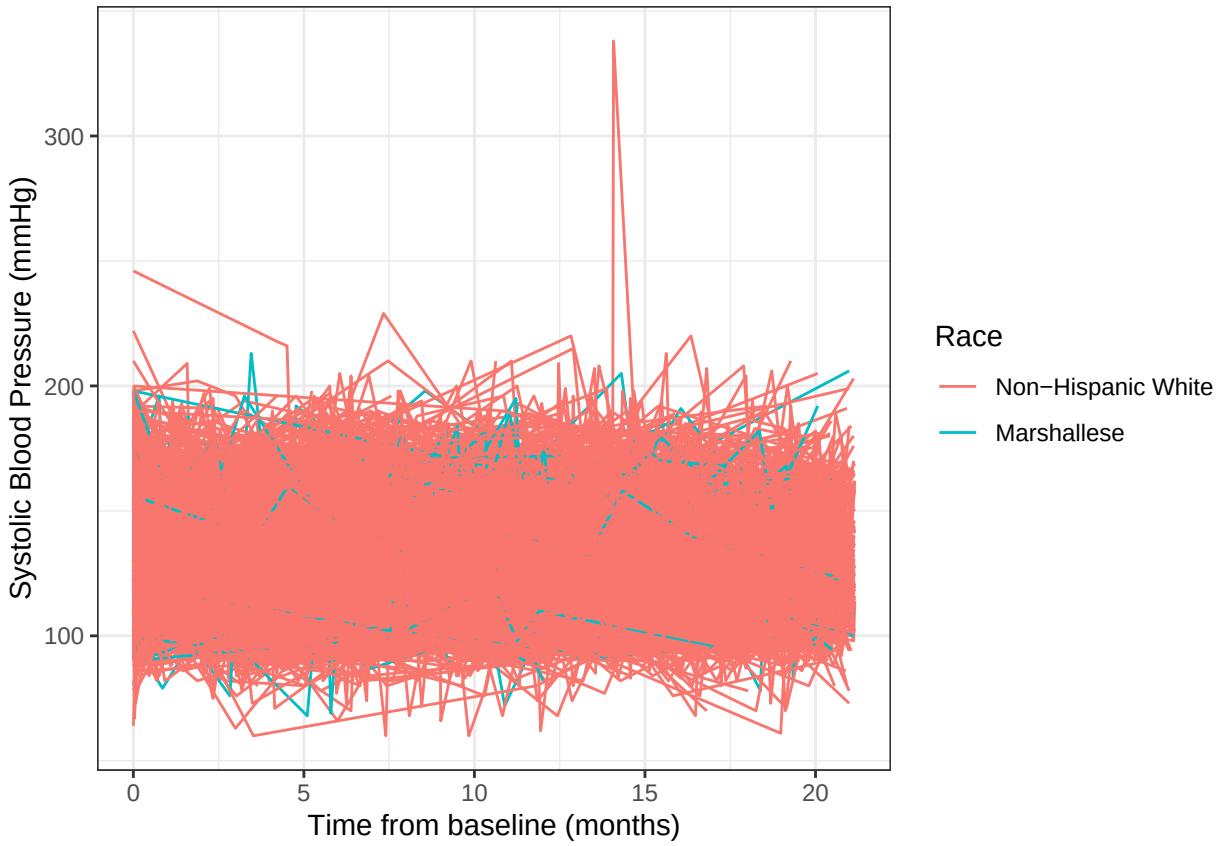
```
bp2$KOHDate <- as.Date('2023-04-05')
bp2$Date <- as.Date(bp2$Date)
bp2.first <- bp2 %>% group_by(UniqueIdentifier) %>% arrange(Date, .by_group=TRUE) %>% slice_head()
bp2.first$Date <- bp2.first$KOHDate
bp2 <- bp2 %>% filter(Date>KOHDate)

bp2 <- rbind(bp2.first, bp2) %>% arrange(UniqueIdentifier, Date)
bp2 <- bp2 %>% mutate(time = round(as.numeric(difftime(Date, KOHDate, units="days"))))

bp2$male <- ifelse(bp2$Sex == 'M', 1, 0)
bp2$Marsh <- factor(bp2$Marsh)

bp2$month.exact <- bp2$time / 30.4

ggplot(data= bp2,
       aes(x=month.exact, y=Systolic, group=UniqueIdentifier, colour=Marsh))+
  geom_line() +
  xlab("Time from baseline (months)") + ylab("Systolic Blood Pressure (mmHg)") + theme_bw() +
  scale_color_discrete(name = "Race", labels=c("Non-Hispanic White", "Marshallese"))
```

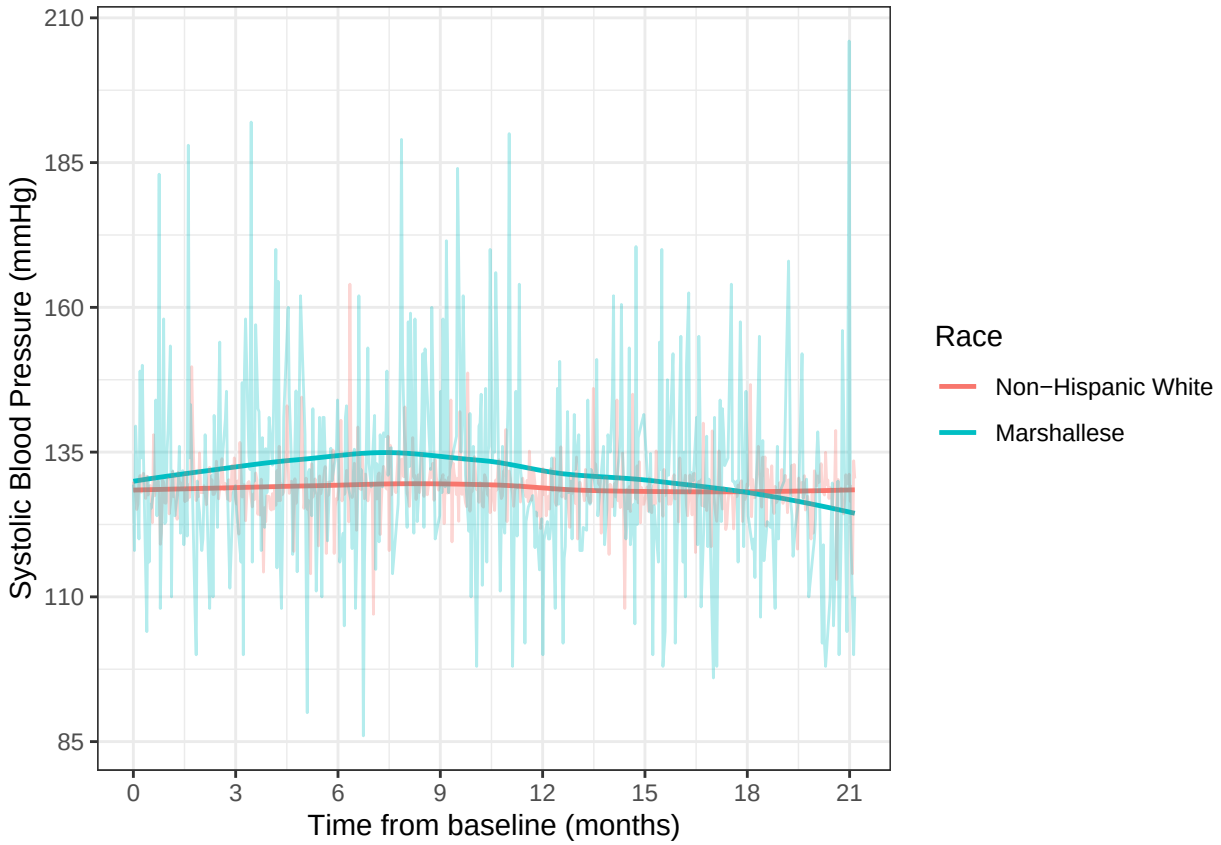



```
summary_bp2 <- bp2 %>% group_by(Marsh, month.exact) %>%
  summarise(mean_bp = mean(Systolic))
```

```
## `summarise()` has grouped output by 'Marsh'. You can override using the
## `.groups` argument.
```

```
ggplot(data=summary_bp2,
       aes(x=month.exact, y=mean_bp, group=Marsh, colour=Marsh))+
  geom_smooth(method=loess, se=FALSE, linewidth=0.85) + geom_line(alpha=0.3) +
  xlab("Time from baseline (months)") + ylab("Systolic Blood Pressure (mmHg)") + theme_bw() +
  scale_color_discrete(name = "Race", labels=c("Non-Hispanic White", "Marshallese")) + scale_x_continuou
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



by month: time x marsh: -6.199612e-02 (-2.248453e-01, 1.008531e-01) (p=0.46); marsh: 1.434512 (-9.570280e-01, 3.826051e+00) (p=0.24); time: -4.298336e-02 (-6.934832e-02, -1.661841e-02) (p=0.0014)

For 1 year: time x marsh: -0.7439535 (-2.698112, 1.210205); marsh: 17.21414 (-11.47765, 45.90593); time: -0.5158004 (-0.8321747, -0.199426)

```
bp.mod2 <- lme(
  fixed = Systolic ~ month.exact * Marsh + age + male + IncomeLevel + avg.bmi,
  random = ~ month.exact | UniqueIdentifier,
  data = bp2,
  method = "REML"
)
summary(bp.mod2)
```

```
## Linear mixed-effects model fit by REML
##   Data: bp2
##        AIC      BIC    logLik
##   329767.7 329870.9 -164871.9
##
## Random effects:
##  Formula: ~month.exact | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev     Corr
## (Intercept) 10.5406306 (Intr)
## month.exact  0.4300466 -0.33
## Residual    13.4622161
##
## Fixed effects:  Systolic ~ month.exact * Marsh + age + male + IncomeLevel + avg.bmi
##                         Value Std.Error    DF   t-value p-value
```

```
## (Intercept)        124.11067 1.1834161 35104 104.87492  0.0000
## month.exact         -0.04298 0.0134513 35104  -3.19548  0.0014
## Marsh1               1.43451 1.2198889  4815   1.17594  0.2397
## age                  0.02896 0.0129480  4815   2.23673  0.0253
## male                 1.83710 0.3345273  4815   5.49162  0.0000
## IncomeLevel         -0.00006 0.0004135  4815  -0.15364  0.8779
## avg.bmi              0.08091 0.0197942  4815   4.08748  0.0000
## month.exact:Marsh1  -0.06200 0.0830850 35104  -0.74618  0.4556
##  Correlation:
##                     (Intr) mnth.x Marsh1 age    male   IncmLv avg.bm
## month.exact         -0.080
## Marsh1              -0.047  0.088
## age                 -0.808 -0.006 -0.007
## male                -0.277  0.003  0.012  0.123
## IncomeLevel         -0.038 -0.002  0.030  0.001 -0.036
## avg.bmi             -0.745 -0.013  0.039  0.269  0.120 -0.016
## month.exact:Marsh1  0.012 -0.162 -0.536  0.001  0.003  0.000  0.002
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -5.70366636 -0.58264560 -0.04079932  0.52093766 14.14200503
##
## Number of Observations: 39927
## Number of Groups: 4821
```

```
intervals(bp.mod2)
```

```
## Approximate 95% confidence intervals
##
##  Fixed effects:
##                             lower          est.         upper
## (Intercept)         1.217911e+02  1.241107e+02  1.264302e+02
## month.exact        -6.934832e-02 -4.298336e-02 -1.661841e-02
## Marsh1             -9.570280e-01  1.434512e+00  3.826051e+00
## age                 3.577237e-03  2.896125e-02  5.434525e-02
## male                1.181270e+00  1.837097e+00  2.492923e+00
## IncomeLevel        -8.742681e-04 -6.353823e-05  7.471916e-04
## avg.bmi             4.210264e-02  8.090830e-02  1.197140e-01
## month.exact:Marsh1 -2.248453e-01 -6.199612e-02  1.008531e-01
##
##  Random Effects:
##   Level: UniqueIdentifier
##                                    lower       est.      upper
## sd((Intercept))              10.1966992 10.5406306 10.8961628
## sd(month.exact)               0.3961615  0.4300466  0.4668300
## cor((Intercept),month.exact) -0.3944407 -0.3299359 -0.2621955
##
##  Within-group standard error:
##    lower     est.    upper
## 13.35824 13.46222 13.56700
```

```
fixed_effects <- summary(bp.mod2)$tTable

# Get estimate and SE for month.from.koh1
month_effect <- fixed_effects["month.exact", "Value"]
```

```r
month_se <- fixed_effects["month.exact", "Std.Error"]

# Compute 12-month estimate and 95% CI
estimate_12m <- 12 * month_effect
se_12m <- 12 * month_se
ci_lower <- estimate_12m - 1.96 * se_12m
ci_upper <- estimate_12m + 1.96 * se_12m

# Display results
cat("12-month estimate:", estimate_12m, "\n")
```

```
## 12-month estimate: -0.5158004
```

```r
cat("95% CI: (", ci_lower, ",", ci_upper, ")\n")
```

```
## 95% CI: ( -0.8321747 , -0.199426 )
```

```r
month_effect <- fixed_effects["Marsh1", "Value"]
month_se <- fixed_effects["Marsh1", "Std.Error"]

month_effect <- fixed_effects["month.exact:Marsh1", "Value"]
month_se <- fixed_effects["month.exact:Marsh1", "Std.Error"]
```

objective 2 A1c 210 marsh; 2349 NHW; 2559 total

```r
a1c2 <- read.csv('Analysis Data/Obj2A1c_LME.csv')[,-1]
length(unique(a1c2$UniqueIdentifier))
```

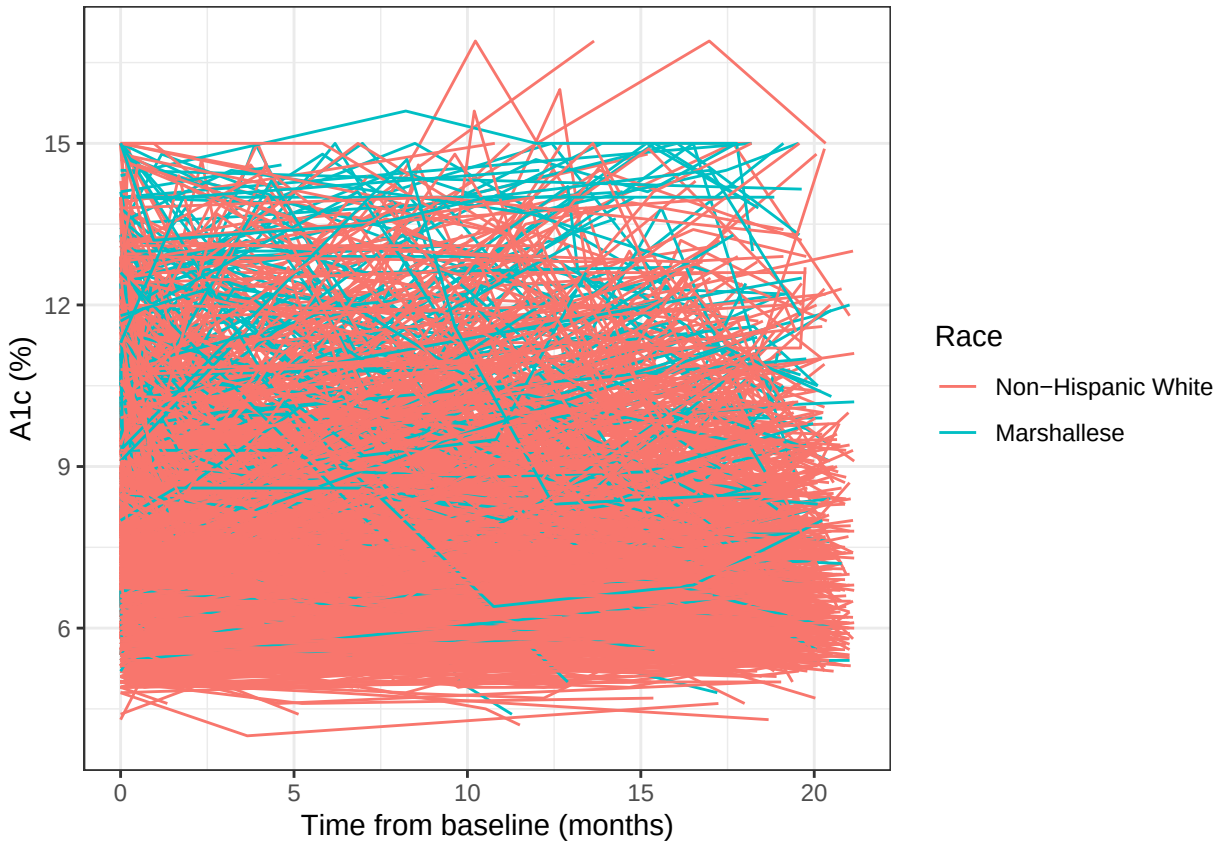
```
## [1] 2559
```

```r
a1c2$KOHDate <- as.Date('2023-04-05')
a1c2$Date <- as.Date(a1c2$Date)
a1c2.first <- a1c2 %>% group_by(UniqueIdentifier) %>% arrange(Date, .by_group=TRUE) %>% slice_head()
a1c2.first$Date <- a1c2.first$KOHDate
a1c2 <- a1c2 %>% filter(Date>KOHDate)

a1c2 <- rbind(a1c2.first, a1c2) %>% arrange(UniqueIdentifier, Date)
a1c2 <- a1c2 %>% mutate(time = round(as.numeric(difftime(Date, KOHDate, units="days"))))

a1c2$male <- ifelse(a1c2$Sex == 'M', 1, 0)
a1c2$Marsh <- factor(a1c2$Marsh)
a1c2$month.exact <- a1c2$time / 30.4

ggplot(data= a1c2,
       aes(x=month.exact, y=A1c, group=UniqueIdentifier, colour=Marsh))+
  geom_line() +
  xlab("Time from baseline (months)") + ylab("A1c (%)") + theme_bw() +
  scale_color_discrete(name = "Race", labels=c("Non-Hispanic White", "Marshallese"))
```

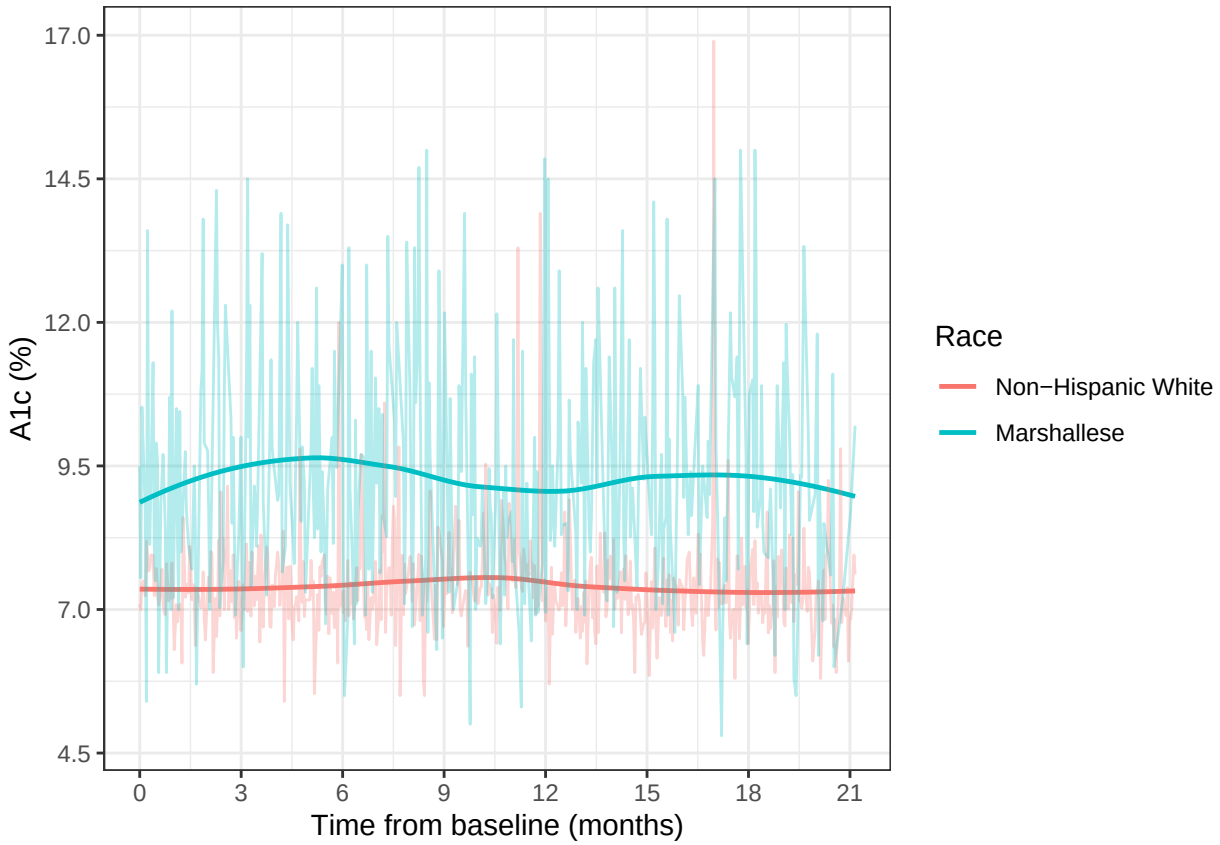



```
summary_a1c2 <- a1c2 %>% group_by(Marsh, month.exact) %>%
  summarise(mean_a1c = mean(A1c))
```

```
## `summarise()` has grouped output by 'Marsh'. You can override using the
## `.groups` argument.
```

```
ggplot(data=summary_a1c2,
       aes(x=month.exact, y=mean_a1c, group=Marsh, colour=Marsh))+
  geom_smooth(method=loess, se=FALSE, linewidth=0.85) + geom_line(alpha=0.3) +
  xlab("Time from baseline (months)") + ylab("A1c (%)") + theme_bw() +
  scale_color_discrete(name = "Race", labels=c("Non-Hispanic White", "Marshallese")) + scale_x_continuou
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



by month: time x marsh: -1.081642e-02 (-0.024975889, 3.343046e-03) (p=0.13); marsh: 2.240465 (1.988022603, 2.492907) (p=0.000); time: 1.109435e-03 (-0.002975881, 5.194750e-03) (p=0.59)

For 1 year: time x marsh: -0.1297971 (-0.2996862, 0.04009212); marsh: 26.88558 (23.85765, 29.9135); time: 0.01331322 (-0.03570352, 0.06232995)

```
a1c.mod2 <- lme(
  fixed = A1c ~ month.exact * Marsh + age + male + IncomeLevel + avg.bmi,
  random = ~ month.exact | UniqueIdentifier,
  data = a1c2,
  method = "REML"
)
summary(a1c.mod2)
```

```
## Linear mixed-effects model fit by REML
##   Data: a1c2
##       AIC      BIC   logLik
##   34962.4 35048.94 -17469.2
##
## Random effects:
##  Formula: ~month.exact | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev     Corr
## (Intercept) 1.58239811 (Intr)
## month.exact 0.05982316 -0.341
## Residual    0.97595820
##
## Fixed effects:  A1c ~ month.exact * Marsh + age + male + IncomeLevel + avg.bmi
##                        Value  Std.Error   DF  t-value p-value
```

```
## (Intercept)         8.458484 0.23132714 7463 36.56503  0.0000
## month.exact         0.001109 0.00208404 7463  0.53235  0.5945
## Marsh1              2.240465 0.12873837 2553 17.40324  0.0000
## age                -0.012218 0.00252122 2553 -4.84610  0.0000
## male                0.248892 0.06419369 2553  3.87721  0.0001
## IncomeLevel        -0.000020 0.00004363 2553 -0.45066  0.6523
## avg.bmi            -0.021279 0.00369552 2553 -5.75811  0.0000
## month.exact:Marsh1 -0.010816 0.00722318 7463 -1.49746  0.1343
##  Correlation:
##                    (Intr) mnth.x Marsh1 age    male   IncmLv avg.bm
## month.exact        -0.062
## Marsh1             -0.191  0.121
## age                -0.798 -0.006  0.063
## male               -0.265  0.003  0.070  0.059
## IncomeLevel        -0.028 -0.001  0.030  0.018 -0.014
## avg.bmi            -0.765 -0.004  0.171  0.275  0.174 -0.021
## month.exact:Marsh1  0.018 -0.289 -0.425  0.000  0.002  0.000  0.002
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -5.1209296 -0.3700971 -0.1085700  0.2395151  6.8297392
##
## Number of Observations: 10024
## Number of Groups: 2559
```

```
intervals(a1c.mod2)
```

```
## Approximate 95% confidence intervals
##
##  Fixed effects:
##                            lower          est.         upper
## (Intercept)         8.005017890  8.458484e+00  8.911951e+00
## month.exact        -0.002975881  1.109435e-03  5.194750e-03
## Marsh1              1.988022603  2.240465e+00  2.492907e+00
## age                -0.017161912 -1.221807e-02 -7.274229e-03
## male                0.123015224  2.488922e-01  3.747692e-01
## IncomeLevel        -0.000105211 -1.966137e-05  6.588821e-05
## avg.bmi            -0.028525695 -2.127918e-02 -1.403267e-02
## month.exact:Marsh1 -0.024975889 -1.081642e-02  3.343046e-03
##
##  Random Effects:
##   Level: UniqueIdentifier
##                                    lower        est.       upper
## sd((Intercept))                1.5291137  1.58239811  1.63753927
## sd(month.exact)                0.0555518  0.05982316  0.06442293
## cor((Intercept),month.exact) -0.4029284 -0.34127358 -0.27653536
##
##  Within-group standard error:
##     lower      est.     upper
## 0.9574853 0.9759582 0.9947875
```

```
fixed_effects <- summary(a1c.mod2)$tTable

# Get estimate and SE for month.from.koh1
month_effect <- fixed_effects["month.exact", "Value"]
```

```r
month_se <- fixed_effects["month.exact", "Std.Error"]

# Compute 12-month estimate and 95% CI
estimate_12m <- 12 * month_effect
se_12m <- 12 * month_se
ci_lower <- estimate_12m - 1.96 * se_12m
ci_upper <- estimate_12m + 1.96 * se_12m

# Display results
cat("12-month estimate:", estimate_12m, "\n")
```

```
## 12-month estimate: 0.01331322
```

```r
cat("95% CI: (", ci_lower, ",", ci_upper, ")\n")
```

```
## 95% CI: ( -0.03570352 , 0.06232995 )
```

```r
month_effect <- fixed_effects["Marsh1", "Value"]
month_se <- fixed_effects["Marsh1", "Std.Error"]

month_effect <- fixed_effects["month.exact:Marsh1", "Value"]
month_se <- fixed_effects["month.exact:Marsh1", "Std.Error"]
```

```r
options(digits=3)
# obj 1 SBP regression result table
##########################################
# format for regression results from models
##########################################

coef_names = c("month.exact:koh.catOne", "month.exact:koh.catMultiple", "koh.catOne", "koh.catMultiple"
col_names = c("est.", "lower", "upper")

# primary objective
obj1_res = data.frame(
  rbind(
    cbind(intervals(a1c.mod1)$fixed[coef_names, col_names], summary(a1c.mod1)$tTable[coef_names, "p-valu
    cbind(intervals(bp.mod1, which="fixed")$fixed[coef_names, col_names], summary(bp.mod1)$tTable[coef_n
  )
)

# obj1_res = data.frame(
#   est = c(summary(mod_o1_a1c)$tTable[coef_names, "Value"], summary(mod_o1_bp)$tTable[coef_names, "Val
#   CI = intervals(mod_o1_a1c)$fixed[coef_names, col_names]
# )

rownames(obj1_res) = c("months:KOHOnce", "months:KOHMultiple", "KOHOnce", "KOHMultiple", "months", "mon
colnames(obj1_res) = c("estimate", "95% CI lower", "95% CI upper", "p-value")

kable(obj1_res) %>% pack_rows("A1c longitudinal", 1, 5) %>% pack_rows("SBP longitudinal", 6, 10)
```

	estimate	95% CI lower	95% CI upper	p-value
A1c longitudinal				
months:KOHOnce	-0.007	-0.131	0.118	0.917
months:KOHMultiple	0.023	-0.070	0.116	0.628
KOHOnce	0.105	-0.902	1.111	0.837
KOHMultiple	-0.411	-1.319	0.498	0.374
months	-0.044	-0.086	-0.003	0.035
SBP longitudinal				
months:KOHOnce	-1.453	-3.811	0.905	0.227
months:KOHMultiple	-0.479	-1.434	0.476	0.325
KOHOnce	4.624	-4.446	13.694	0.315
KOHMultiple	2.443	-4.792	9.679	0.505
months	0.327	-0.129	0.783	0.159

```r
# secondary objective
coef_names = c("month.exact:Marsh1", "Marsh1", "month.exact")
col_names = c("est.", "lower", "upper")

obj2_res = data.frame(
  rbind(
    cbind(intervals(a1c.mod2, which="fixed")$fixed[coef_names, col_names], summary(a1c.mod2)$tTable[coe
    cbind(intervals(bp.mod2, which="fixed")$fixed[coef_names, col_names], summary(bp.mod2)$tTable[coef_n
  )
)
```

```r
# obj1_res = data.frame(
#   est = c(summary(mod_o1_a1c)$tTable[coef_names, "Value"], summary(mod_o1_bp)$tTable[coef_names, "Val
#   CI = intervals(mod_o1_a1c)$fixed[coef_names, col_names]
# )

rownames(obj2_res) = c("months:Marshallese","Marshallese", "months", "months:Marshallese ","Marshallese
colnames(obj2_res) = c("estimate", "95% CI lower", "95% CI upper", "p-value")

kable(obj2_res) %>% pack_rows("A1c longitudinal", 1, 3) %>% pack_rows("SBP longitudinal", 4, 6)
```

	estimate	95% CI lower	95% CI upper	p-value
A1c longitudinal				
months:Marshallese	-0.011	-0.025	0.003	0.134
Marshallese	2.240	1.988	2.493	0.000
months	0.001	-0.003	0.005	0.595
SBP longitudinal				
months:Marshallese	-0.062	-0.225	0.101	0.456
Marshallese	1.435	-0.957	3.826	0.240
months	-0.043	-0.069	-0.017	0.001