Pre Post Analysis

Max Bi

2025-03-02

```
KOH1 = as.Date("2023-04-05")
o1_bp = read_csv("Analysis Data/Obj1BPPrePost.csv")
```

```
## New names:
## Rows: 240 Columns: 16
## -- Column specification
## -------------------------------------------------------- Delimiter: "," chr
## (1): Sex dbl (13): ...1, UniqueIdentifier, sys, dia, KOH, koh.counts, KOH.none,
## KOH.... date (2): BPDate, KOHDate
## i Use `spec()` to retrieve the full column specification for this data. i
## Specify the column types or set `show_col_types = FALSE` to quiet this message.
## * `` -> `...1`
```

```
names(o1_bp)[1] = "row_id"
o1_a1c = read_csv("Analysis Data/Obj1A1cPrePost.csv")
```

```
## New names:
## Rows: 394 Columns: 15
## -- Column specification
## -------------------------------------------------------- Delimiter: "," chr
## (1): Sex dbl (12): ...1, UniqueIdentifier, A1c, KOH, koh.counts, KOH.none,
## KOH.one, ... date (2): A1cDate, KOHDate
## i Use `spec()` to retrieve the full column specification for this data. i
## Specify the column types or set `show_col_types = FALSE` to quiet this message.
## * `` -> `...1`
```

```
names(o1_a1c)[1] = "row_id"
o2_bp = read_csv("Analysis Data/Obj2BPPrePost.csv")
```

```
## New names:
## Rows: 9642 Columns: 12
## -- Column specification
## -------------------------------------------------------- Delimiter: "," chr
## (2): Group, Sex dbl (9): ...1, UniqueIdentifier, Systolic, Diastolic, Marsh,
## age, IncomeLev... date (1): Date
## i Use `spec()` to retrieve the full column specification for this data. i
## Specify the column types or set `show_col_types = FALSE` to quiet this message.
## * `` -> `...1`
```

```
names(o2_bp)[1] = "row_id"
o2_a1c = read_csv("Analysis Data/Obj2A1cPrePost.csv")
```

```
## New names:
## Rows: 5118 Columns: 11
## -- Column specification
```

```
## ------------------------------------------------------- Delimiter: "," chr
## (2): Group, Sex dbl (8): ...1, UniqueIdentifier, A1c, Marsh, age, IncomeLevel,
## BLACERISK, a... date (1): Date
## i Use `spec()` to retrieve the full column specification for this data. i
## Specify the column types or set `show_col_types = FALSE` to quiet this message.
## * `` -> `...1`
```

```
names(o2_a1c)[1] = "row_id"
DAYS_IN_MONTH = 30.4
```

```
# attendees
#   measured before 1st KOH visit: change date to 1st KOH visit
#   measured after 1st KOH visit: keep date
# non-attendees
#   measured before KOH 1: change date to KOH 1
#   measured after KOH 1: DNE
std_times = o1_bp %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(BPDate),
    post_Date = max(BPDate),
    std_time = ifelse(BPDate == pre_Date, 0, ifelse(
      KOH == 0,
      as.numeric(post_Date - KOH1),
      ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - KOHDate))
    ))
  ) %>%
  select(std_time) %>%
  ungroup() %>%
  mutate(
    row_id = as.numeric(o1_bp[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)
```

```
## Warning: Returning more (or less) than 1 row per `summarise()` group was deprecated in
## dplyr 1.1.0.
## i Please use `reframe()` instead.
## i When switching from `summarise()` to `reframe()`, remember that `reframe()`
##   always returns an ungrouped data frame and adjust accordingly.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## `summarise()` has grouped output by 'UniqueIdentifier'. You can override using
## the `.groups` argument.
## Adding missing grouping variables: `UniqueIdentifier`
```

```
o1_bp = left_join(o1_bp, std_times, by="row_id")
o1_bp = o1_bp %>% mutate(
  Sex = ifelse(o1_bp$Sex == "M", 1, 0),
  koh_cat = as.factor(case_when(
    KOH.none == 1 ~ "None",
    KOH.one == 1 ~ "One",
    KOH.mult == 1 ~ "Multiple"
  ))
)
```

```
std_times = o1_a1c %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(A1cDate),
    post_Date = max(A1cDate),
    std_time = ifelse(A1cDate == pre_Date, 0, ifelse(
      KOH == 0,
      as.numeric(post_Date - KOH1),
      ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - KOHDate))
    ))
  ) %>%
  select(std_time) %>%
  ungroup() %>%
  mutate(
    row_id = as.numeric(o1_a1c[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)
```

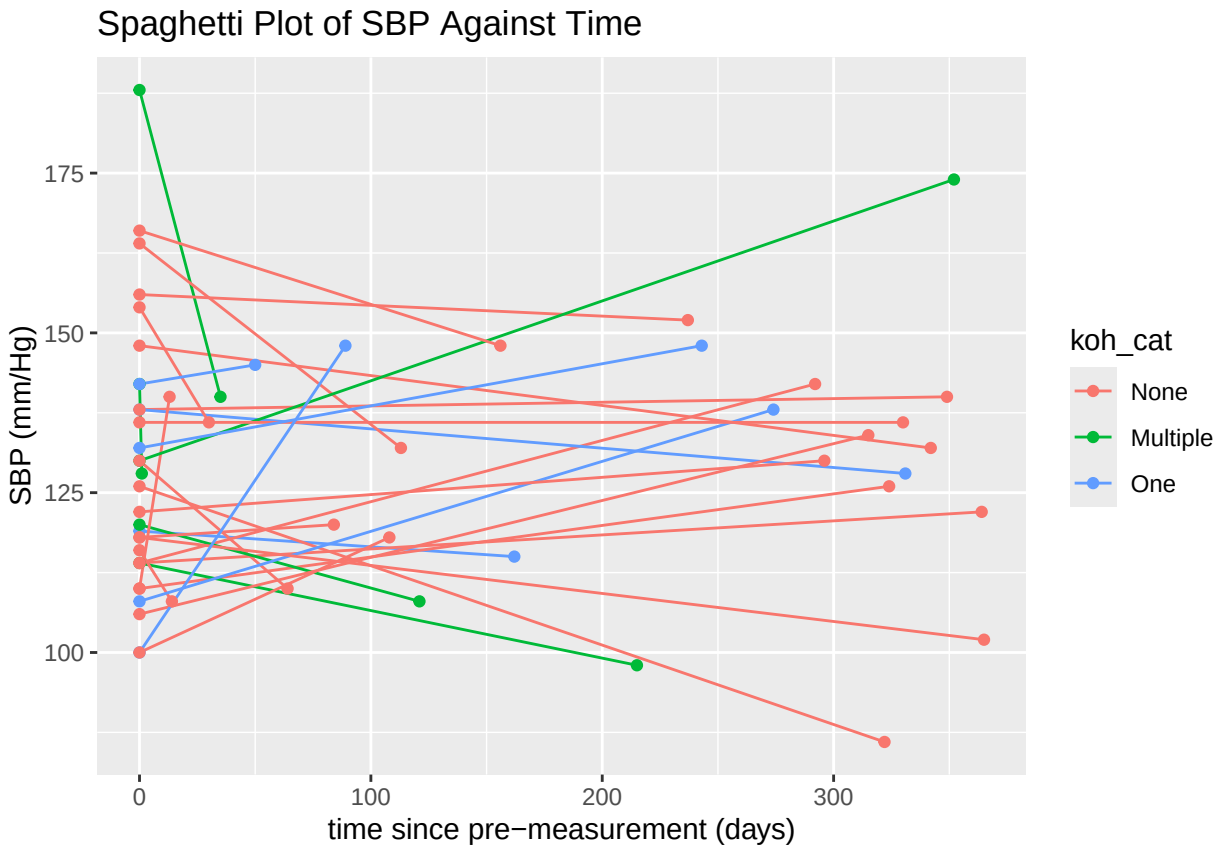
```
## Warning: Returning more (or less) than 1 row per `summarise()` group was deprecated in
## dplyr 1.1.0.
## i Please use `reframe()` instead.
## i When switching from `summarise()` to `reframe()`, remember that `reframe()`
##   always returns an ungrouped data frame and adjust accordingly.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## `summarise()` has grouped output by 'UniqueIdentifier'. You can override using
## the `.groups` argument.
## Adding missing grouping variables: `UniqueIdentifier`
```

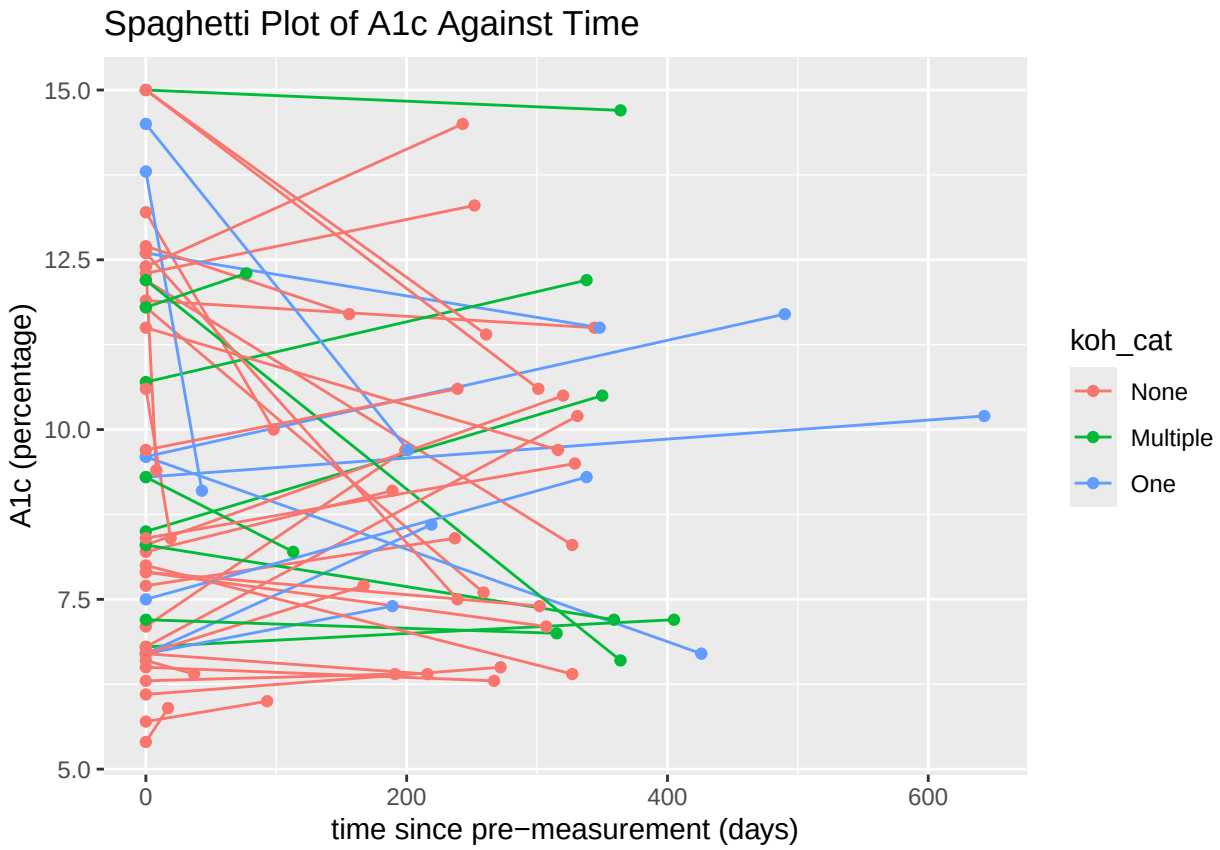
```
o1_a1c = left_join(o1_a1c, std_times, by="row_id")
o1_a1c = o1_a1c %>% mutate(
  Sex = ifelse(o1_a1c$Sex == "M", 1, 0),
  koh_cat = as.factor(case_when(
    KOH.none == 1 ~ "None",
    KOH.one == 1 ~ "One",
    KOH.mult == 1 ~ "Multiple"
  ))
)

o1_bp$koh_cat <- relevel(o1_bp$koh_cat, ref = "None")
o1_a1c$koh_cat <- relevel(o1_a1c$koh_cat, ref = "None")
```

```
o1_bp_ids = o1_bp$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.25 * nrow(o1_bp))
o1_bp_pdt = o1_bp %>% filter(UniqueIdentifier %in% o1_bp_ids)
ggplot(data=o1_bp_pdt, mapping=aes(x=std_time, y=sys, group=UniqueIdentifier, color=koh_cat)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of SBP Against Time",
    x="time since pre-measurement (days)",
    y="SBP (mm/Hg)"
  )
```




```
o1_a1c_ids = o1_a1c$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.25 * nrow(o1_a1c))
o1_a1c_pdt = o1_a1c %>% filter(UniqueIdentifier %in% o1_a1c_ids)
ggplot(data=o1_a1c_pdt, mapping=aes(x=std_time, y=A1c, group=UniqueIdentifier, color=koh_cat)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of A1c Against Time",
    x="time since pre-measurement (days)",
    y="A1c (percentage)"
  )
```




```
mod_o1_bp = lme(
  fixed = sys ~ std_months * koh_cat + age + Sex + IncomeLevel + BLACERISK + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o1_bp,
  method = "REML"
)
summary(mod_o1_bp)
```

```
## Linear mixed-effects model fit by REML
##   Data: o1_bp
##    AIC  BIC logLik
##   2116 2167  -1043
##
## Random effects:
##  Formula: ~std_months | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev   Corr
## (Intercept) 1.16e+01 (Intr)
## std_months  9.07e-04 0
## Residual    1.64e+01
##
## Fixed effects:  sys ~ std_months * koh_cat + age + Sex + IncomeLevel + BLACERISK +      avg.bmi
##                              Value Std.Error  DF t-value p-value
## (Intercept)                 100.8     14.72 117    6.84  0.0000
## std_months                    0.0      0.28 117   -0.02  0.9871
## koh_catMultiple               1.5      4.68 112    0.31  0.7534
## koh_catOne                    1.8      5.68 112    0.31  0.7556
```

```
## age                           0.2      0.16 112    1.00  0.3216
## Sex                           5.8      3.17 112    1.81  0.0724
## IncomeLevel                   0.0      0.03 112   -0.01  0.9954
## BLACERISK                    -0.6      0.74 112   -0.86  0.3940
## avg.bmi                       0.6      0.30 112    1.99  0.0495
## std_months:koh_catMultiple    0.1      0.61 117    0.11  0.9149
## std_months:koh_catOne         0.4      0.76 117    0.53  0.5955
##  Correlation:
##                              (Intr) std_mn kh_ctM kh_ctO age    Sex    IncmLv
## std_months                   -0.006
## koh_catMultiple               0.041  0.237
## koh_catOne                    0.040  0.202  0.196
## age                          -0.757 -0.042 -0.207 -0.124
## Sex                          -0.101 -0.044 -0.008 -0.034  0.036
## IncomeLevel                  -0.221  0.014 -0.064  0.118  0.374 -0.176
## BLACERISK                    -0.100 -0.002 -0.036  0.032 -0.159 -0.194 -0.060
## avg.bmi                      -0.746 -0.063  0.058 -0.044  0.185  0.054 -0.132
## std_months:koh_catMultiple    0.033 -0.452 -0.515 -0.099  0.026  0.028 -0.035
## std_months:koh_catOne        -0.041 -0.369 -0.088 -0.516  0.051  0.065 -0.010
##                              BLACER avg.bm st_:_M
## std_months
## koh_catMultiple
## koh_catOne
## age
## Sex
## IncomeLevel
## BLACERISK
## avg.bmi                       0.131
## std_months:koh_catMultiple -0.035 -0.017
## std_months:koh_catOne        -0.045  0.060  0.167
##
## Standardized Within-Group Residuals:
##     Min      Q1     Med      Q3     Max
## -2.4366 -0.5780 -0.0767  0.4984  2.7401
##
## Number of Observations: 240
## Number of Groups: 120
```

```
mod_o1_a1c = lme(
  fixed = A1c ~ std_months * koh_cat + age + Sex + IncomeLevel + BLACERISK + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o1_a1c,
  method = "REML"
)
summary(mod_o1_a1c)
```

```
## Linear mixed-effects model fit by REML
##   Data: o1_a1c
##    AIC  BIC logLik
##   1770 1829   -870
##
## Random effects:
##  Formula: ~std_months | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev Corr
```

```
## (Intercept) 2.235  (Intr)
## std_months  0.153  -0.483
## Residual    1.138
##
## Fixed effects:  A1c ~ std_months * koh_cat + age + Sex + IncomeLevel + BLACERISK +      avg.bmi
##                             Value Std.Error  DF t-value p-value
## (Intercept)                 14.97     1.358 194   11.02  0.0000
## std_months                  -0.05     0.021 194   -2.45  0.0153
## koh_catMultiple             -0.38     0.485 189   -0.77  0.4398
## koh_catOne                   0.31     0.535 189    0.58  0.5648
## age                         -0.06     0.015 189   -3.71  0.0003
## Sex                          0.00     0.325 189    0.01  0.9956
## IncomeLevel                  0.00     0.002 189    0.53  0.5991
## BLACERISK                   -0.05     0.082 189   -0.62  0.5378
## avg.bmi                     -0.07     0.029 189   -2.38  0.0183
## std_months:koh_catMultiple   0.04     0.047 194    0.76  0.4487
## std_months:koh_catOne        0.02     0.055 194    0.37  0.7102
##  Correlation:
##                             (Intr) std_mn kh_ctM kh_ctO age    Sex    IncmLv
## std_months                  -0.074
## koh_catMultiple              0.075  0.220
## koh_catOne                  -0.052  0.200  0.199
## age                         -0.711 -0.012 -0.170 -0.174
## Sex                         -0.066 -0.002  0.037 -0.001  0.015
## IncomeLevel                 -0.291 -0.010 -0.046 -0.011  0.314 -0.178
## BLACERISK                   -0.086 -0.010 -0.001  0.120 -0.183 -0.131 -0.035
## avg.bmi                     -0.747  0.011 -0.059  0.121  0.138  0.000  0.020
## std_months:koh_catMultiple   0.035 -0.453 -0.483 -0.089  0.000  0.001  0.000
## std_months:koh_catOne        0.040 -0.385 -0.083 -0.434 -0.003  0.013 -0.024
##                             BLACER avg.bm st_:_M
## std_months
## koh_catMultiple
## koh_catOne
## age
## Sex
## IncomeLevel
## BLACERISK
## avg.bmi                      0.078
## std_months:koh_catMultiple   0.012 -0.003
## std_months:koh_catOne        0.005 -0.013  0.174
##
## Standardized Within-Group Residuals:
##     Min      Q1     Med      Q3     Max
## -1.8968 -0.4062 -0.0485  0.3958  2.0901
##
## Number of Observations: 394
## Number of Groups: 197
```

```r
# measured before KOH 1: change date to KOH 1
# measured after KOH 1: keep date
std_times = o2_bp %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(Date),
```

```
    post_Date = max(Date),
    std_time = ifelse(
      Date == pre_Date,
      0,
      # ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - pre_Date))
      as.numeric(post_Date - pre_Date)
    )
  ) %>%
  select(std_time) %>%
  ungroup() %>%
  mutate(
    row_id = as.numeric(o2_bp[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)
```

```
## Warning: Returning more (or less) than 1 row per `summarise()` group was deprecated in
## dplyr 1.1.0.
## i Please use `reframe()` instead.
## i When switching from `summarise()` to `reframe()`, remember that `reframe()`
##   always returns an ungrouped data frame and adjust accordingly.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## `summarise()` has grouped output by 'UniqueIdentifier'. You can override using
## the `.groups` argument.
## Adding missing grouping variables: `UniqueIdentifier`
```

```
o2_bp = left_join(o2_bp, std_times, by="row_id")
o2_bp = o2_bp %>% mutate(Sex = ifelse(o2_bp$Sex == "M", 1, 0))

std_times = o2_a1c %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(Date),
    post_Date = max(Date),
    std_time = ifelse(
      Date == pre_Date,
      0,
      # ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - pre_Date))
      as.numeric(post_Date - KOH1)
    )
  ) %>%
  select(std_time) %>%
  ungroup() %>%
  mutate(
    row_id = as.numeric(o2_a1c[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)
```

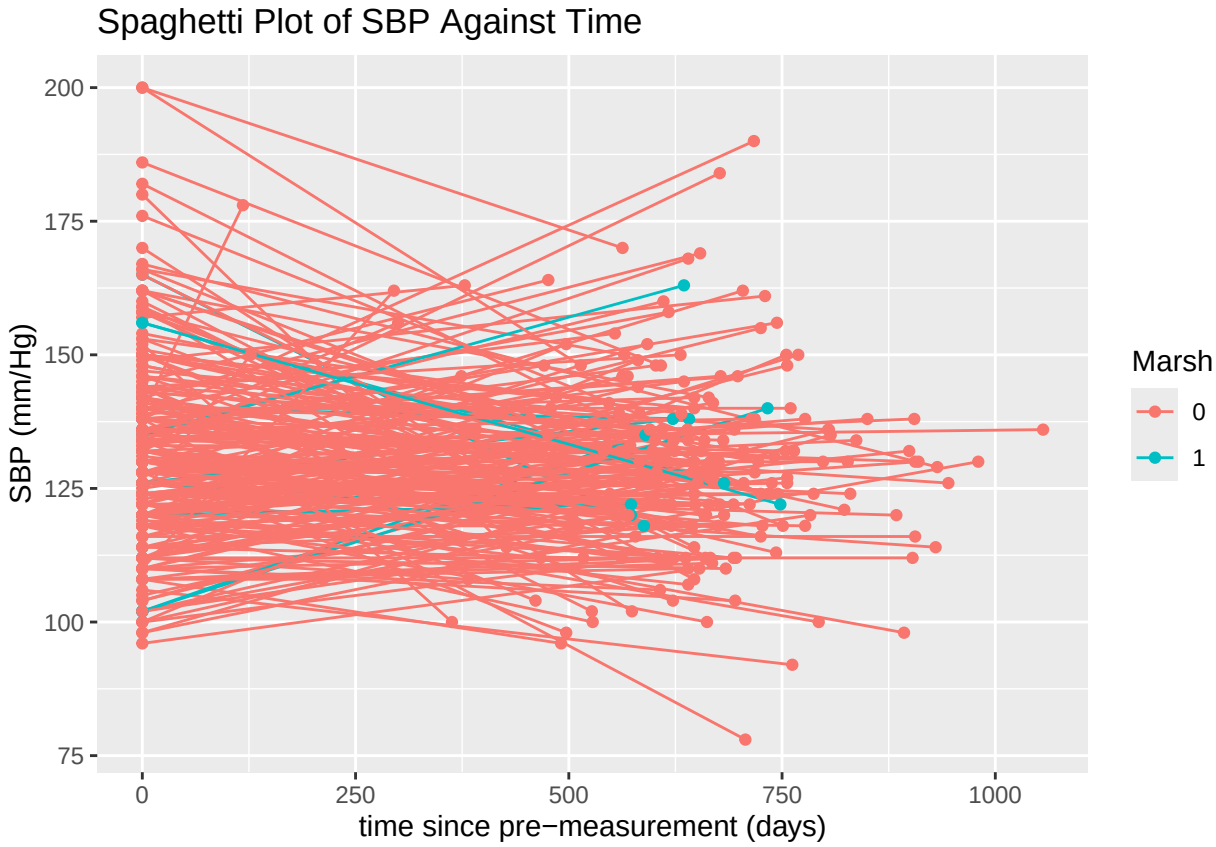
```
## Warning: Returning more (or less) than 1 row per `summarise()` group was deprecated in
## dplyr 1.1.0.
## i Please use `reframe()` instead.
## i When switching from `summarise()` to `reframe()`, remember that `reframe()`
```

```
##   always returns an ungrouped data frame and adjust accordingly.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## `summarise()` has grouped output by 'UniqueIdentifier'. You can override using
## the `.groups` argument.
## Adding missing grouping variables: `UniqueIdentifier`
```

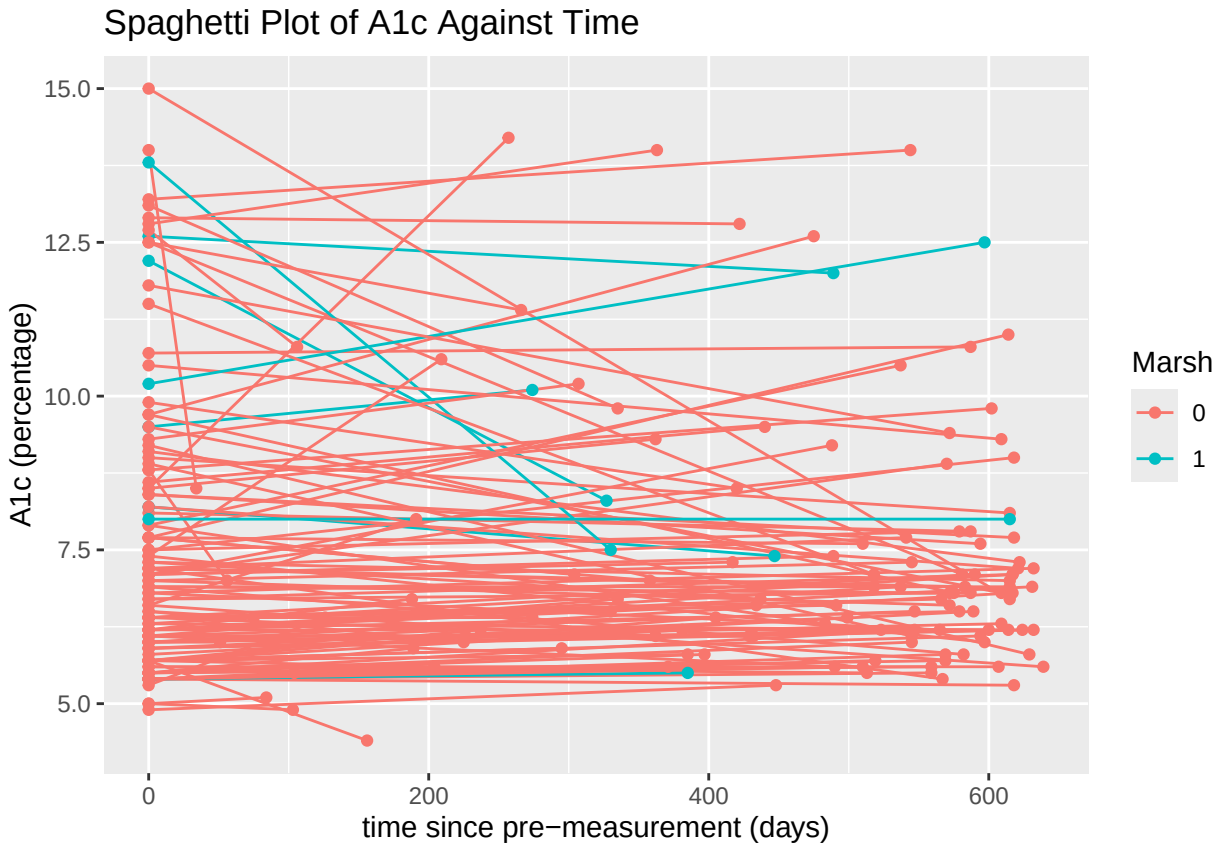
```
o2_a1c = left_join(o2_a1c, std_times, by="row_id")
o2_a1c = o2_a1c %>% mutate(Sex = ifelse(o2_a1c$Sex == "M", 1, 0))
```

```
o2_bp_ids = o2_bp$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.05 * nrow(o2_bp))
o2_bp_pdt = o2_bp %>% filter(UniqueIdentifier %in% o2_bp_ids) %>% mutate(Marsh = as.factor(Marsh))
ggplot(data=o2_bp_pdt, mapping=aes(x=std_time, y=Systolic, group=UniqueIdentifier, color=Marsh)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of SBP Against Time",
    x="time since pre-measurement (days)",
    y="SBP (mm/Hg)"
  )
```




```
o2_a1c_ids = o2_a1c$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.05 * nrow(o2_a1c))
o2_a1c_pdt = o2_a1c %>% filter(UniqueIdentifier %in% o2_a1c_ids) %>% mutate(Marsh = as.factor(Marsh))
ggplot(data=o2_a1c_pdt, mapping=aes(x=std_time, y=A1c, group=UniqueIdentifier, color=Marsh)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of A1c Against Time",
```

```
    x="time since pre-measurement (days)",
    y="A1c (percentage)"
  )
```




```
mod_o2_bp = lme(
  fixed = Systolic ~ std_months * Marsh + age + Sex + IncomeLevel + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o2_bp,
  method = "REML"
)
summary(mod_o2_bp)
```

```
## Linear mixed-effects model fit by REML
##   Data: o2_bp
##     AIC   BIC logLik
##   80867 80953 -40422
##
## Random effects:
##  Formula: ~std_months | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev Corr
## (Intercept)  9.33  (Intr)
## std_months   0.21  -0.293
## Residual    13.48
##
## Fixed effects:  Systolic ~ std_months * Marsh + age + Sex + IncomeLevel + avg.bmi
##                   Value Std.Error   DF t-value p-value
```

```
## (Intercept)      123.6     1.351 4819    91.5  0.0000
## std_months        -0.1     0.014 4819    -5.5  0.0000
## Marsh              0.3     1.445 4815     0.2  0.8520
## age                0.0     0.015 4815     2.6  0.0097
## Sex                2.2     0.382 4815     5.7  0.0000
## IncomeLevel        0.0     0.000 4815    -0.5  0.6107
## avg.bmi            0.1     0.023 4815     3.8  0.0002
## std_months:Marsh  -0.1     0.087 4819    -1.0  0.3214
##  Correlation:
##                   (Intr) std_mn Marsh  age    Sex    IncmLv avg.bm
## std_months        -0.088
## Marsh             -0.047  0.094
## age               -0.805 -0.011 -0.006
## Sex               -0.280  0.002  0.014  0.126
## IncomeLevel       -0.040 -0.002  0.030  0.002 -0.036
## avg.bmi           -0.743 -0.010  0.035  0.264  0.119 -0.016
## std_months:Marsh   0.013 -0.158 -0.573  0.000  0.004  0.000  0.003
##
## Standardized Within-Group Residuals:
##     Min      Q1     Med      Q3     Max
## -3.4920 -0.5442 -0.0438  0.4580  5.0072
##
## Number of Observations: 9642
## Number of Groups: 4821
```

```
mod_o2_a1c = lme(
  fixed = A1c ~ std_months * Marsh + age + Sex + IncomeLevel + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o2_a1c,
  method = "REML"
)
summary(mod_o2_a1c)
```

```
## Linear mixed-effects model fit by REML
##   Data: o2_a1c
##     AIC   BIC logLik
##   19638 19716  -9807
##
## Random effects:
##  Formula: ~std_months | UniqueIdentifier
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev Corr
## (Intercept) 1.5986 (Intr)
## std_months  0.0549 -0.456
## Residual    0.9979
##
## Fixed effects:  A1c ~ std_months * Marsh + age + Sex + IncomeLevel + avg.bmi
##                   Value Std.Error   DF t-value p-value
## (Intercept)        8.35    0.2355 2557    35.5  0.0000
## std_months         0.00    0.0022 2557    -0.7  0.4538
## Marsh              2.29    0.1366 2553    16.8  0.0000
## age               -0.01    0.0026 2553    -4.5  0.0000
## Sex                0.26    0.0654 2553     4.0  0.0001
## IncomeLevel        0.00    0.0000 2553    -0.6  0.5674
## avg.bmi           -0.02    0.0038 2553    -5.3  0.0000
```

```
## std_months:Marsh -0.01    0.0076 2557    -1.6  0.1175
##  Correlation:
##                  (Intr) std_mn Marsh  age    Sex    IncmLv avg.bm
## std_months       -0.072
## Marsh            -0.186  0.140
## age              -0.796 -0.010  0.059
## Sex              -0.265  0.005  0.068  0.059
## IncomeLevel      -0.028 -0.001  0.029  0.018 -0.013
## avg.bmi          -0.765 -0.006  0.163  0.275  0.175 -0.022
## std_months:Marsh  0.021 -0.287 -0.491  0.001  0.001  0.000  0.002
##
## Standardized Within-Group Residuals:
##    Min     Q1    Med     Q3    Max
## -3.211 -0.330 -0.126  0.193  4.934
##
## Number of Observations: 5118
## Number of Groups: 2559
```

Tables of Regression Results

```
##########################################
# format for regression results from models
##########################################

coef_names = c("std_months:koh_catOne", "std_months:koh_catMultiple", "koh_catOne", "koh_catMultiple",
col_names = c("est.", "lower", "upper")

# primary objective
obj1_res = data.frame(
  rbind(
    cbind(intervals(mod_o1_a1c)$fixed[coef_names, col_names], summary(mod_o1_a1c)$tTable[coef_names, "p
    cbind(intervals(mod_o1_bp, which="fixed")$fixed[coef_names, col_names], summary(mod_o1_bp)$tTable[c
  )
)

# 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)[4] = "p-value"

kable(obj1_res) %>% pack_rows("a1c_pre_post", 1, 5) %>% pack_rows("sbp_pre_post", 6, 10)
```

	est.	lower	upper	p-value
a1c_pre_post				
months:KOHonce	0.021	-0.088	0.129	0.710
months:KOHmultiple	0.036	-0.057	0.128	0.449
KOHonce	0.309	-0.747	1.364	0.565
KOHmultiple	-0.375	-1.331	0.581	0.440
months	-0.052	-0.094	-0.010	0.015
sbp_pre_post				
months:KOHonce	0.404	-1.098	1.906	0.596
months:KOHmultiple	0.065	-1.140	1.271	0.915
KOHonce	1.771	-9.474	13.016	0.756
KOHmultiple	1.474	-7.802	10.751	0.753
months	-0.004	-0.551	0.542	0.987

```
# secondary objective
coef_names = c("std_months:Marsh", "Marsh", "std_months")
col_names = c("est.", "lower", "upper")

obj1_res = data.frame(
  rbind(
    cbind(intervals(mod_o2_a1c, which="fixed")$fixed[coef_names, col_names], summary(mod_o2_a1c)$tTable
    cbind(intervals(mod_o2_bp, which="fixed")$fixed[coef_names, col_names], summary(mod_o2_bp)$tTable[c
  )
)
```

```
# 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:Marsh","Marsh", "months", "months:Marsh ","Marsh ", "months ")
colnames(obj1_res)[4] = "p-value"

kable(obj1_res) %>% pack_rows("a1c_pre_post", 1, 3) %>% pack_rows("sbp_pre_post", 4, 6)
```

	est.	lower	upper	p-value
a1c_pre_post				
months:Marsh	-0.012	-0.027	0.003	0.118
Marsh	2.292	2.025	2.560	0.000
months	-0.002	-0.006	0.003	0.454
sbp_pre_post				
months:Marsh	-0.087	-0.258	0.085	0.321
Marsh	0.270	-2.564	3.103	0.852
months	-0.076	-0.103	-0.049	0.000

```
# table for undajusted baseline results
o1_a1c_bltb = o1_a1c %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(A1cDate),
    A1c = ifelse(A1cDate == pre_Date, A1c, NA),
    koh_cat = koh_cat
  ) %>%
  drop_na()
```

```
## Warning: Returning more (or less) than 1 row per `summarise()` group was deprecated in
## dplyr 1.1.0.
## i Please use `reframe()` instead.
## i When switching from `summarise()` to `reframe()`, remember that `reframe()`
##   always returns an ungrouped data frame and adjust accordingly.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

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

```
o1_bp_bltb = o1_bp %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(BPDate),
    sys = ifelse(BPDate == pre_Date, sys, NA),
    koh_cat = koh_cat
  ) %>%
  drop_na()
```

```
## Warning: Returning more (or less) than 1 row per `summarise()` group was deprecated in
## dplyr 1.1.0.
## i Please use `reframe()` instead.
```

```
## i When switching from `summarise()` to `reframe()`, remember that `reframe()`
##   always returns an ungrouped data frame and adjust accordingly.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

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

```
o1_bltb = data.frame(
  KOHnever = c(mean((o1_a1c_bltb %>% filter(koh_cat == "None"))$A1c), mean((o1_bp_bltb %>% filter(koh_ca
    KOHonce = c(mean((o1_a1c_bltb %>% filter(koh_cat == "One"))$A1c), mean((o1_bp_bltb %>% filter(koh_ca
    KOHmultiple = c(mean((o1_a1c_bltb %>% filter(koh_cat == "Multiple"))$A1c), mean((o1_bp_bltb %>% filt
)

rownames(o1_bltb) = c("A1c", "SBP")

kable(o1_bltb)
```

	KOHnever	KOHonce	KOHmultiple
A1c	9.73	10.1	8.97
SBP	128.47	130.0	131.26

Code Appendix

```
knitr::opts_chunk$set(echo = TRUE)
library(tidyverse)
library(nlme)
library(kableExtra)
# source("primary_obj_data.R")
# source("secondary_obj_data.R")
options(digits=3)
KOH1 = as.Date("2023-04-05")
o1_bp = read_csv("Analysis Data/Obj1BPPrePost.csv")
names(o1_bp)[1] = "row_id"
o1_a1c = read_csv("Analysis Data/Obj1A1cPrePost.csv")
names(o1_a1c)[1] = "row_id"
o2_bp = read_csv("Analysis Data/Obj2BPPrePost.csv")
names(o2_bp)[1] = "row_id"
o2_a1c = read_csv("Analysis Data/Obj2A1cPrePost.csv")
names(o2_a1c)[1] = "row_id"
DAYS_IN_MONTH = 30.4
# attendees
#   measured before 1st KOH visit: change date to 1st KOH visit
#   measured after 1st KOH visit: keep date
# non-attendees
#   measured before KOH 1: change date to KOH 1
#   measured after KOH 1: DNE
std_times = o1_bp %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(BPDate),
    post_Date = max(BPDate),
    std_time = ifelse(BPDate == pre_Date, 0, ifelse(
      KOH == 0,
      as.numeric(post_Date - KOH1),
      ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - KOHDate))
    ))
  ) %>%
  select(std_time) %>%
  ungroup() %>%
  mutate(
    row_id = as.numeric(o1_bp[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)

o1_bp = left_join(o1_bp, std_times, by="row_id")
o1_bp = o1_bp %>% mutate(
  Sex = ifelse(o1_bp$Sex == "M", 1, 0),
  koh_cat = as.factor(case_when(
    KOH.none == 1 ~ "None",
    KOH.one == 1 ~ "One",
    KOH.mult == 1 ~ "Multiple"
  ))
)
```

```r
std_times = o1_a1c %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(A1cDate),
    post_Date = max(A1cDate),
    std_time = ifelse(A1cDate == pre_Date, 0, ifelse(
      KOH == 0,
      as.numeric(post_Date - KOH1),
      ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - KOHDate))
    ))
  ) %>%
  select(std_time) %>%
  ungroup() %>%
  mutate(
    row_id = as.numeric(o1_a1c[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)

o1_a1c = left_join(o1_a1c, std_times, by="row_id")
o1_a1c = o1_a1c %>% mutate(
  Sex = ifelse(o1_a1c$Sex == "M", 1, 0),
  koh_cat = as.factor(case_when(
    KOH.none == 1 ~ "None",
    KOH.one == 1 ~ "One",
    KOH.mult == 1 ~ "Multiple"
  ))
)

o1_bp$koh_cat <- relevel(o1_bp$koh_cat, ref = "None")
o1_a1c$koh_cat <- relevel(o1_a1c$koh_cat, ref = "None")
o1_bp_ids = o1_bp$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.25 * nrow(o1_bp))
o1_bp_pdt = o1_bp %>% filter(UniqueIdentifier %in% o1_bp_ids)
ggplot(data=o1_bp_pdt, mapping=aes(x=std_time, y=sys, group=UniqueIdentifier, color=koh_cat)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of SBP Against Time",
    x="time since pre-measurement (days)",
    y="SBP (mm/Hg)"
  )

o1_a1c_ids = o1_a1c$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.25 * nrow(o1_a1c))
o1_a1c_pdt = o1_a1c %>% filter(UniqueIdentifier %in% o1_a1c_ids)
ggplot(data=o1_a1c_pdt, mapping=aes(x=std_time, y=A1c, group=UniqueIdentifier, color=koh_cat)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of A1c Against Time",
    x="time since pre-measurement (days)",
    y="A1c (percentage)"
  )
mod_o1_bp = lme(
```

```
  fixed = sys ~ std_months * koh_cat + age + Sex + IncomeLevel + BLACERISK + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o1_bp,
  method = "REML"
)
summary(mod_o1_bp)

mod_o1_a1c = lme(
  fixed = A1c ~ std_months * koh_cat + age + Sex + IncomeLevel + BLACERISK + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o1_a1c,
  method = "REML"
)
summary(mod_o1_a1c)
# measured before KOH 1: change date to KOH 1
# measured after KOH 1: keep date
std_times = o2_bp %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(Date),
    post_Date = max(Date),
    std_time = ifelse(
      Date == pre_Date,
      0,
      # ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - pre_Date))
      as.numeric(post_Date - pre_Date)
    )
  ) %>%
  select(std_time) %>%
  ungroup() %>%
  mutate(
    row_id = as.numeric(o2_bp[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)

o2_bp = left_join(o2_bp, std_times, by="row_id")
o2_bp = o2_bp %>% mutate(Sex = ifelse(o2_bp$Sex == "M", 1, 0))

std_times = o2_a1c %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(Date),
    post_Date = max(Date),
    std_time = ifelse(
      Date == pre_Date,
      0,
      # ifelse(pre_Date < KOH1, as.numeric(post_Date - KOH1), as.numeric(post_Date - pre_Date))
      as.numeric(post_Date - KOH1)
    )
  ) %>%
  select(std_time) %>%
  ungroup() %>%
```

```
  mutate(
    row_id = as.numeric(o2_a1c[["row_id"]]),
    std_months = std_time / DAYS_IN_MONTH
  ) %>%
  select(std_time, std_months, row_id)

o2_a1c = left_join(o2_a1c, std_times, by="row_id")
o2_a1c = o2_a1c %>% mutate(Sex = ifelse(o2_a1c$Sex == "M", 1, 0))
o2_bp_ids = o2_bp$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.05 * nrow(o2_bp))
o2_bp_pdt = o2_bp %>% filter(UniqueIdentifier %in% o2_bp_ids) %>% mutate(Marsh = as.factor(Marsh))
ggplot(data=o2_bp_pdt, mapping=aes(x=std_time, y=Systolic, group=UniqueIdentifier, color=Marsh)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of SBP Against Time",
    x="time since pre-measurement (days)",
    y="SBP (mm/Hg)"
  )

o2_a1c_ids = o2_a1c$UniqueIdentifier %>% unique() %>% sample(0.5 * 0.05 * nrow(o2_a1c))
o2_a1c_pdt = o2_a1c %>% filter(UniqueIdentifier %in% o2_a1c_ids) %>% mutate(Marsh = as.factor(Marsh))
ggplot(data=o2_a1c_pdt, mapping=aes(x=std_time, y=A1c, group=UniqueIdentifier, color=Marsh)) +
  geom_line() +
  geom_point() +
  labs(
    title="Spaghetti Plot of A1c Against Time",
    x="time since pre-measurement (days)",
    y="A1c (percentage)"
  )
mod_o2_bp = lme(
  fixed = Systolic ~ std_months * Marsh + age + Sex + IncomeLevel + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o2_bp,
  method = "REML"
)
summary(mod_o2_bp)

mod_o2_a1c = lme(
  fixed = A1c ~ std_months * Marsh + age + Sex + IncomeLevel + avg.bmi,
  random = ~ std_months | UniqueIdentifier,
  data = o2_a1c,
  method = "REML"
)
summary(mod_o2_a1c)
##########################################
# format for regression results from models
##########################################

coef_names = c("std_months:koh_catOne", "std_months:koh_catMultiple", "koh_catOne", "koh_catMultiple",
col_names = c("est.", "lower", "upper")

# primary objective
obj1_res = data.frame(
```

```
  rbind(
    cbind(intervals(mod_o1_a1c)$fixed[coef_names, col_names], summary(mod_o1_a1c)$tTable[coef_names, "p
    cbind(intervals(mod_o1_bp, which="fixed")$fixed[coef_names, col_names], summary(mod_o1_bp)$tTable[co
  )
)

# 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)[4] = "p-value"

kable(obj1_res) %>% pack_rows("a1c_pre_post", 1, 5) %>% pack_rows("sbp_pre_post", 6, 10)

# secondary objective
coef_names = c("std_months:Marsh", "Marsh", "std_months")
col_names = c("est.", "lower", "upper")

obj1_res = data.frame(
  rbind(
    cbind(intervals(mod_o2_a1c, which="fixed")$fixed[coef_names, col_names], summary(mod_o2_a1c)$tTable
    cbind(intervals(mod_o2_bp, which="fixed")$fixed[coef_names, col_names], summary(mod_o2_bp)$tTable[co
  )
)

# 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:Marsh","Marsh", "months", "months:Marsh ","Marsh ", "months ")
colnames(obj1_res)[4] = "p-value"

kable(obj1_res) %>% pack_rows("a1c_pre_post", 1, 3) %>% pack_rows("sbp_pre_post", 4, 6)
# table for undajusted baseline results
o1_a1c_bltb = o1_a1c %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(A1cDate),
    A1c = ifelse(A1cDate == pre_Date, A1c, NA),
    koh_cat = koh_cat
  ) %>%
  drop_na()

o1_bp_bltb = o1_bp %>%
  group_by(UniqueIdentifier) %>%
  summarize(
    pre_Date = min(BPDate),
    sys = ifelse(BPDate == pre_Date, sys, NA),
    koh_cat = koh_cat
  ) %>%
```

```
  drop_na()

o1_bltb = data.frame(
  KOHnever = c(mean((o1_a1c_bltb %>% filter(koh_cat == "None"))$A1c), mean((o1_bp_bltb %>% filter(koh_ca
    KOHonce = c(mean((o1_a1c_bltb %>% filter(koh_cat == "One"))$A1c), mean((o1_bp_bltb %>% filter(koh_ca
    KOHmultiple = c(mean((o1_a1c_bltb %>% filter(koh_cat == "Multiple"))$A1c), mean((o1_bp_bltb %>% filt
)

rownames(o1_bltb) = c("A1c", "SBP")

kable(o1_bltb)
```