

** This Program is the data assembly and analysis code for the Lymphocytes and Systolic Blood Pressure Paper as of December 2019 **;

/* First, assemble original lymphocyte data */

```
libname lib 'U:\T Cell Project\Data';
libname LIB2 'U:\T Cell Project\Nels\';
```

```
data quat;
set lib2.colleen_enhanced (keep=idno samp_weight);
run;
```

```
data check_1;
set lib.MESA_Data_export_20170120;
```

```
idno=mesaid;
if LIVE LYMPH_COUNT < 0 then LIVE LYMPH_COUNT =. ;
if LIVE LYMPH_COUNT_8 < 0 then LIVE LYMPH_COUNT_8 =. ;
if cd4_mnas_mesa_final_CD4_ < 0 then cd4_mnas_mesa_final_CD4_ =. ;
if CD4_CD45RA_ < 0 then CD4_CD45RA_ =. ;
if CD4_CD45RO_ < 0 then CD4_CD45RO_ =. ;
if CD4_CD28_CD57_ < 0 then CD4_CD28_CD57_ =. ;
if CD4_CD38_ < 0 then CD4_CD38_ =. ;
if CD4_CD28_ < 0 then CD4_CD28_ =. ;
if CD4_CD45RA_CD28_CD57__AS_CD4 < 0 then CD4_CD45RA_CD28_CD57__AS_CD4 =. ;
if CD4_CD57_ < 0 then CD4_CD57_ =. ;
if cd8_mnas_mesa_final_CD8_ < 0 then cd8_mnas_mesa_final_CD8_ =. ;
if CD8_CD45RA_ < 0 then CD8_CD45RA_ =. ;
if CD8_CD45RO_ < 0 then CD8_CD45RO_ =. ;
if CD8_CD28_CD57_ < 0 then CD8_CD28_CD57_ =. ;
if CD8_CD38_ < 0 then CD8_CD38_ =. ;
if CD8_CD28_ < 0 then CD8_CD28_ =. ;
if CD8_CD45RA_CD28_CD57__AS_CD8 < 0 then CD8_CD45RA_CD28_CD57__AS_CD8 =. ;
if CD8_CD57_ < 0 then CD8_CD57_ =. ;
if cd3_ < 0 then cd3_ =. ;
if cd3_gd_ < 0 then cd3_gd_ =. ;
if NK_lymphs < 0 then NK_lymphs =. ;
if B_CELLS < 0 then B_CELLS =. ;
if cd4_cd25_ < 0 then cd4_cd25_ =. ;
if cd6_cd127_cd4_cd25_as_lymphs < 0 then cd6_cd127_cd4_cd25_as_lymphs =. ;
if cd4_cd25_cd6dim < 0 then cd4_cd25_cd6dim =. ;
if CD14_CD16_ < 0 then CD14_CD16_ =. ;
if CD14_CD16_ < 0 then CD14_CD16_ =. ;
if xx < 0 then xx =. ;
if mesa_th1_final_CD4_ < 0 then mesa_th1_final_CD4_ =. ;
if mesa_th1_final_CD8_ < 0 then mesa_th1_final_CD8_ =. ;
if th1_as_cd4 < 0 then th1_as_cd4 =. ;
if th2_as_cd4 < 0 then th2_as_cd4 =. ;
if th17_as_cd4 < 0 then th17_as_cd4 =. ;
if cd8IFNas_cd8 < 0 then cd8IFNas_cd8 =. ;
if cd8il4_as_cd8 < 0 then cd8il4_as_cd8 =. ;
if cd8il17_as_cd8 < 0 then cd8il17_as_cd8 =. ;
```

```
label cd4_mnas_mesa_final_CD4_ = ' CD4+ cells (as % lymphs)' ;
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label CD4_CD45RA_ = ' cd4+ Naïve Cells (as % CD4+ cells)' ;
label CD4_CD45RO_ = ' CD4+ Memory Cells (as % CD4+ Cells)' ;
label CD4_CD28_CD57_ = ' Immunosenescent Subpopulation of CD4+ Cells (as % of CD4+ Cells)' ;
label CD4_CD38_ = ' Activated CD4 Cells (as % CD4+ Cells)' ;
label CD4_CD28_ = ' Immunosenescent CD4+ Cells (as % of CD4+ Cells)' ;
label CD4_CD45RA_CD28_CD57__AS_CD4 = ' CD4+cd45RA re-expressing senescent cells (as %CD4+ cells)' ;
label CD4_CD57_ = ' Measure of chronic immune activation on CD4+ cells' ;
label cd8_mnas_mesa_final_CD8_ = ' cd8+ cells (as % lymphs)' ;
label CD8_CD45RA_ = ' cd8+ Naïve Cells (as % CD8+ cells)' ;
label CD8_CD45RO_ = ' CD8+ Memory Cells (as % CD8+ Cells)' ;
label CD8_CD28_CD57_ = ' Immunosenescent Subpopulation CD8+ Cells (as % of CD8+ Cells)' ;
label CD8_CD38_ = ' Activated CD8 Cells (as % CD8+ Cells)' ;
label CD8_CD28_ = ' Immunosenescent CD8+ Cells (as % of CD8+ Cells)' ;
label CD8_CD45RA_CD28_CD57__AS_CD8 = ' cd8+cd45RA re-expressing senescent cells (as %CD8+ cells)' ;
label CD8_CD57_ = ' Measure of chronic immune activation on CD8+ cells' ;
label cd3_ = ' CD3+ Cells (as % Lymphs)' ;
label cd3_gd_ = ' gamma delta T cells (as % Lymphs)' ;
label NK_lymphs = ' Natural Killer Cells (as % lymphs)' ;
label B_CELLS = ' CD19+ Cells (As % lymphs)' ;
label cd4_cd25_ = ' T regulatory cells (as a % of lymphs)' ;
label cd6_cd127_cd4_cd25__as_lymphs = ' FoxP3-type T regulatory Cell (as % lymphs)' ;
label cd4_cd25_cd6dim = ' Another reported measure of FoxP3-type T regulatory cells' ;
label CD14_CD16_ = ' Classic Monocytes' ;
label CD14_CD16_ = ' Intermediate Monocytes' ;
label xx = ' non-classic monocytes' ;
label mesa_th1_final_CD4_ = ' CD4+ cells (as % lymphs)' ;
label mesa_th1_final_CD8_ = ' cd8+ cells (as % lymphs)' ;
label th1_as_cd4 = ' cd4+ifn+ as % CD4+ (TH1)' ;
label th2_as_cd4 = ' cd4+il4+ as %CD4+ (Th2)' ;
label th17_as_cd4 = ' CD4+IL17+ as %CD4+ (IL17)' ;
label cd8IFNas_cd8 = ' cd8+ifn+ as %CD8+' ;
label cd8il4_as_cd8 = ' cd8+il4+ as %cd8+' ;
label cd8il17_as_cd8 = ' cd8+il17+ as %CD8+' ;

```

```

q=sum(xx,CD14_CD16_,CD14_CD16_);
CD14_CD16_2 = (CD14_CD16_/q)*100;
CD14_CD16_2 = (CD14_CD16_/q)*100;
xx2 = (xx/q)*100;

```

run;

```

proc sort data=check_1;
by idno;
run;

```

```

data lib.Lymphocytes_MESA_July_5_2018;
merge check_1 (in=ina) quat (in=inb);
by idno;

```

```

if ina;
if inb;

```

run;

```
proc means;
run;

proc sort data=check_1;
by idno;
run;
proc sort data=lib.cmv;
by idno;
run;

proc means;
where xx ne . and NK_lymphs ne .;
run;

data check;
merge check_1 lib.cmv;
by idno;
if cmv=-999 then cmv=.;
if cmv=-555 then cmv=960;
if cmv=-333 then cmv=0.01;
if cmv=-888 then cmv=.;
log_cmv=log(cmv+1);

run;

proc means maxdec=2;
var
th1_as_cd4
th17_as_cd4
CD4_CD38_
CD8_CD38_
NK_lymphs
cd3_gd_
CD14_CD16_

th2_as_cd4
XX

cd4_cd25_
CD14_CD16_

CD4_CD45RA_
CD8_CD45RA_
CD4_CD28_
CD8_CD28_
CD4_CD45R0_
CD8_CD45R0_

cd4_mnas_mesa_final_CD4_
CD4_CD28_CD57_
CD4_CD45RA_CD28_CD57__AS_CD4
CD4_CD57_
cd8_mnas_mesa_final_CD8_
CD8_CD28_CD57_
CD8_CD45RA_CD28_CD57__AS_CD8
```

```

CD8_CD57_
cd3_
B_CELLS
cd6_cd127_cd4_cd25_as__lymphs
cd4_cd25_cd6dim
mesa_th1_final_CD4_
mesa_th1_final_CD8_
cd8IFNas_cd8
cd8il4_as_cd8
cd8il17_as_cd8
cmv
;
run;

proc sort data=check nodupkey;
by idno;
run;

/* Second, Assemble longitudinal data
   Divide lymphocyte subsets (in %) by standard deviations for scaling */

/*Covariates: smoking, diabetes, physical activity, and baseline body mass index.
These are the primary risk factors for hypertension.*/

data one_p;
merge check (in=in) lib.Mesaefinallabel05072015 (keep=idno age1c gender1 race1c sbp1c ace1c aced1c c
cursmk1 dm031c curalc1 bmi1c chol1 exercm1c educ1 il61 chol1 hdl1 sttn1c cmv1);
by idno;
if ina;
sbp=sbp1c;
dbp=dbp1c;
time=0;

if dm031c> 1 then diabetes=1;
else diabetes=0;

ace=max(ace1c,aced1c);
ccb=ccb1c;
diur=max(aced1c, diur1c, betad1c, vasod1c);
beta=max(betad1c, beta1c);
vaso=max(vaso1c, vasod1c);
if RACE1C=1 then r1=1;
else r1=0;
if RACE1C=2 then r2=1;
else r2=0;
if RACE1C=3 then r3=1;
else r3=0;
if RACE1C=4 then r4=1;
else r4=0;
any_ah=max(ace,ccb,diur,beta,vaso);
age=age1c;
if gender1=1 then male=1;

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else male=0;

if any_ah=1 then sbp_adj=sbp+10;
else sbp_adj=sbp;
if educ1>6 then college=1;
else college=0;

cd4_mnas_mesa_final_CD4_      = cd4_mnas_mesa_final_CD4_      / 11.0148293 ;
CD4_CD45RA_ = CD4_CD45RA_ / 12.0481371 ;
CD4_CD45RO_ = CD4_CD45RO_ / 13.4133922 ;
CD4_CD28_CD57_ = CD4_CD28_CD57_ / 8.4565482 ;
LIVE_LYMPH_COUNT = LIVE_LYMPH_COUNT / 7044.02 ;
CD4_CD38_ = CD4_CD38_ / 12.1331635 ;
CD4_CD28_ = CD4_CD28_ / 10.0446624 ;
CD4_CD45RA_CD28_CD57__AS_CD4 = CD4_CD45RA_CD28_CD57__AS_CD4 / 5.3288475 ;
CD4_CD57_ = CD4_CD57_ / 12.9488516 ;
cd8_mnas_mesa_final_CD8_ = cd8_mnas_mesa_final_CD8_ / 9.3385893 ;
CD8_CD45RA_ = CD8_CD45RA_ / 14.6668267 ;
CD8_CD45RO_ = CD8_CD45RO_ / 10.6215264 ;
CD8_CD28_CD57_ = CD8_CD28_CD57_ / 15.8827921 ;
LIVE_LYMPH_COUNT_8 = LIVE_LYMPH_COUNT_8 / 7381.23 ;
CD8_CD38_ = CD8_CD38_ / 12.1970917 ;
CD8_CD28_ = CD8_CD28_ / 15.9305801 ;
CD8_CD45RA_CD28_CD57__AS_CD8 = CD8_CD45RA_CD28_CD57__AS_CD8 / 14.2740251 ;
CD8_CD57_ = CD8_CD57_ / 15.4380623 ;
cd3_ = cd3_ / 13.6970536 ;
cd3_gd_ = cd3_gd_ / 4.0324039 ;
NK_lymphs = NK_lymphs / 5.6925374 ;
B_CELLS = B_CELLS / 7.3817656 ;
cd4_cd25_ = cd4_cd25_ / 7.1005486 ;
cd6_cd127_cd4_cd25__as__lymphs = cd6_cd127_cd4_cd25__as__lymphs / 0.5234053 ;
cd4_cd25_cd6dim = cd4_cd25_cd6dim / 3.7634147 ;
CD14_CD16_ = CD14_CD16_ / 12.8157347 ;
CD14_CD16_ = CD14_CD16_ / 4.9169505 ;
XX = XX / 3.2611816 ;
mesa_th1_final_CD4_ = mesa_th1_final_CD4_ / 13.5738544 ;
mesa_th1_final_CD8_ = mesa_th1_final_CD8_ / 8.3438174 ;
th1_as_cd4 = th1_as_cd4 / 8.9953262 ;
th2_as_cd4 = th2_as_cd4 / 1.7477505 ;
th17_as_cd4 = th17_as_cd4 / 1.4328386 ;
cd8IFNas_cd8 = cd8IFNas_cd8 / 17.8840879 ;
cd8il4_as_cd8 = cd8il4_as_cd8 / 4.9215664 ;
cd8il17_as_cd8 = cd8il17_as_cd8 / 5.7672104 ;

CD14_CD16_3 = CD14_CD16_2 / 10.2084227 ;
CD14_CD16_3 = CD14_CD16_2 / 7.1003813 ;
XX3 = XX2 / 7.5327375 ;

run;

proc means;
var male;

```

```

run;

proc means data=one_p;
var age male r2 r3 r4 LIVE_LYMPH_COUNT sbp ace ccb diur beta vaso any;
run;

proc contents data=lib.mesadiet2;
run;
proc sort data=lib.mesadiet2;
by idno;
run;

data one;
merge one_p (in=ina) lib.mesadiet2 (keep=idno wine liquor beer);
by idno;
if ina;

if beer='OM' or wine ='OM' or liquor ='OM' then add_alc=1;
else if beer ne . then add_alc=0;

if curalc1 ne . then curalc1r=curalc1;
else if add_alc=1 then curalc1r=1;
else if add_alc=0 then curalc1r=0;
run;

proc means ;
var curalc1 curalc1r;
run;

proc freq;
tables wine liquor beer;
run;

data two;
merge check (in=ina) lib.Mesae2finallabel02132015 (keep=idno e12dyc age2c age1c gender1 race1c sbp2c
dm032c curalc2 bmi2c exercm2c);
by idno;
if ina;
sbp=sbp2c;
dbp=dbp2c;
time=e12dyc/365;
age=age2c;

ace=max(ace2c,aced2c);
ccb=ccb2c;
diur=max(aced2c, diur2c, betad2c, vasod2c);
beta=max(betad2c, beta2c);
vaso=max(vaso2c, vasod2c);
any_ah=max(ace,ccb,diur,beta,vaso);
if any_ah=1 then sbp_adj=sbp+10;
else sbp_adj=sbp;cd4_mnas_mesa_final_CD4_      =      cd4_mnas_mesa_final_CD4_      /      11.0148293   ;
CD4_CD45RA_ =      CD4_CD45RA_ /      12.0481371   ;

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```

CD4_CD45R0_ = CD4_CD45R0_ / 13.4133922 ;
CD4_CD28_CD57_ = CD4_CD28_CD57_ / 8.4565482 ;
LIVE_LYMPH_COUNT = LIVE_LYMPH_COUNT / 7044.02 ;
CD4_CD38_ = CD4_CD38_ / 12.1331635 ;
CD4_CD28_ = CD4_CD28_ / 10.0446624 ;
CD4_CD45RA_CD28_CD57__AS_CD4 = CD4_CD45RA_CD28_CD57__AS_CD4 / 5.3288475 ;
CD4_CD57_ = CD4_CD57_ / 12.9488516 ;
cd8_mnas_mesa_final_CD8_ = cd8_mnas_mesa_final_CD8_ / 9.3385893 ;
CD8_CD45RA_ = CD8_CD45RA_ / 14.6668267 ;
CD8_CD45R0_ = CD8_CD45R0_ / 10.6215264 ;
CD8_CD28_CD57_ = CD8_CD28_CD57_ / 15.8827921 ;
LIVE_LYMPH_COUNT_8 = LIVE_LYMPH_COUNT_8 / 7381.23 ;
CD8_CD38_ = CD8_CD38_ / 12.1970917 ;
CD8_CD28_ = CD8_CD28_ / 15.9305801 ;
CD8_CD45RA_CD28_CD57__AS_CD8 = CD8_CD45RA_CD28_CD57__AS_CD8 / 14.2740251 ;
CD8_CD57_ = CD8_CD57_ / 15.4380623 ;
cd3_ = cd3_ / 13.6970536 ;
cd3_gd_ = cd3_gd_ / 4.0324039 ;
NK_lymphs = NK_lymphs / 5.6925374 ;
B_CELLS = B_CELLS / 7.3817656 ;
cd4_cd25_ = cd4_cd25_ / 7.1005486 ;
cd6_cd127_cd4_cd25__as__lymphs = cd6_cd127_cd4_cd25__as__lymphs / 0.5234053 ;
cd4_cd25_cd6dim = cd4_cd25_cd6dim / 3.7634147 ;
CD14_CD16_ = CD14_CD16_ / 12.8157347 ;
CD14_CD16_ = CD14_CD16_ / 4.9169505 ;
XX = XX / 3.2611816 ;
mesa_th1_final_CD4_ = mesa_th1_final_CD4_ / 13.5738544 ;
mesa_th1_final_CD8_ = mesa_th1_final_CD8_ / 8.3438174 ;
th1_as_cd4 = th1_as_cd4 / 8.9953262 ;
th2_as_cd4 = th2_as_cd4 / 1.7477505 ;
th17_as_cd4 = th17_as_cd4 / 1.4328386 ;
cd8IFNas_cd8 = cd8IFNas_cd8 / 17.8840879 ;
cd8il4_as_cd8 = cd8il4_as_cd8 / 4.9215664 ;
cd8il17_as_cd8 = cd8il17_as_cd8 / 5.7672104 ;

CD14_CD16_3 = CD14_CD16_2 / 10.2084227 ;
CD14_CD16_3 = CD14_CD16_2 / 7.1003813 ;
XX3 = XX2 / 7.5327375 ;

```

run;

```

data three;
merge check (in=ina) lib.Mesae3finallabel02132015 (keep=idno e13dyc age3c age1c gender1 race1c sbp3c
cursmk3 dm033c curalc3 bmi3c dbp3c exercm3c);
by idno;
if ina;
sbp=sbp3c;
dbp=dbp3c;
time=e13dyc/365;
age=age3c;

ace=max(ace3c,aced3c);
ccb=ccb3c;
diur=max(aced3c, diur3c, betad3c, vasod3c);

```

```

beta=max(beta3c, beta3c);
vaso=max(vaso3c, vasod3c);
any_ah=max(ace,ccb,diur,beta,vaso);
if any_ah=1 then sbp_adj=sbp+10;
else sbp_adj=sbp;cd4_mnas_mesa_final_CD4_ = cd4_mnas_mesa_final_CD4_ / 11.0148293 ;
CD4_CD45RA_ = CD4_CD45RA_ / 12.0481371 ;
CD4_CD45R0_ = CD4_CD45R0_ / 13.4133922 ;
CD4_CD28_CD57_ = CD4_CD28_CD57_ / 8.4565482 ;
LIVE_LYMPH_COUNT = LIVE_LYMPH_COUNT / 7044.02 ;
CD4_CD38_ = CD4_CD38_ / 12.1331635 ;
CD4_CD28_ = CD4_CD28_ / 10.0446624 ;
CD4_CD45RA_CD28_CD57__AS_CD4 = CD4_CD45RA_CD28_CD57__AS_CD4 / 5.3288475 ;
CD4_CD57_ = CD4_CD57_ / 12.9488516 ;
cd8_mnas_mesa_final_CD8_ = cd8_mnas_mesa_final_CD8_ / 9.3385893 ;
CD8_CD45RA_ = CD8_CD45RA_ / 14.6668267 ;
CD8_CD45R0_ = CD8_CD45R0_ / 10.6215264 ;
CD8_CD28_CD57_ = CD8_CD28_CD57_ / 15.8827921 ;
LIVE_LYMPH_COUNT_8 = LIVE_LYMPH_COUNT_8 / 7381.23 ;
CD8_CD38_ = CD8_CD38_ / 12.1970917 ;
CD8_CD28_ = CD8_CD28_ / 15.9305801 ;
CD8_CD45RA_CD28_CD57__AS_CD8 = CD8_CD45RA_CD28_CD57__AS_CD8 / 14.2740251 ;
CD8_CD57_ = CD8_CD57_ / 15.4380623 ;
cd3_ = cd3_ / 13.6970536 ;
cd3_gd_ = cd3_gd_ / 4.0324039 ;
NK_lymphs = NK_lymphs / 5.6925374 ;
B_CELLS = B_CELLS / 7.3817656 ;
cd4_cd25_ = cd4_cd25_ / 7.1005486 ;
cd6_cd127_cd4_cd25__as__lymphs = cd6_cd127_cd4_cd25__as__lymphs / 0.5234053 ;
cd4_cd25_cd6dim = cd4_cd25_cd6dim / 3.7634147 ;
CD14_CD16_ = CD14_CD16_ / 12.8157347 ;
CD14_CD16_ = CD14_CD16_ / 4.9169505 ;
XX = XX / 3.2611816 ;
mesa_th1_final_CD4_ = mesa_th1_final_CD4_ / 13.5738544 ;
mesa_th1_final_CD8_ = mesa_th1_final_CD8_ / 8.3438174 ;
th1_as_cd4 = th1_as_cd4 / 8.9953262 ;
th2_as_cd4 = th2_as_cd4 / 1.7477505 ;
th17_as_cd4 = th17_as_cd4 / 1.4328386 ;
cd8IFNas_cd8 = cd8IFNas_cd8 / 17.8840879 ;
cd8il4_as_cd8 = cd8il4_as_cd8 / 4.9215664 ;
cd8il17_as_cd8 = cd8il17_as_cd8 / 5.7672104 ;

CD14_CD16_3 = CD14_CD16_2 / 10.2084227 ;
CD14_CD16_3 = CD14_CD16_2 / 7.1003813 ;
XX3 = XX2 / 7.5327375 ;

run;

data four;
merge check (in=ina) lib.Mesae4finallabel02172015 (keep=idno e14dyc age4c gender1 race1c sbp4c ace4c a
cursmk4 dm034c curalc4 bmi4c dbp4c);
by idno;
if ina;
sbp=sbp4c;
dbp=dbp4c;
time=e14dyc/365;
age=age4c;

```

```

cd4_mnas_mesa_final_CD4_ = cd4_mnas_mesa_final_CD4_ / 11.0148293 ;
CD4_CD45RA_ = CD4_CD45RA_ / 12.0481371 ;
CD4_CD45RO_ = CD4_CD45RO_ / 13.4133922 ;
CD4_CD28_CD57_ = CD4_CD28_CD57_ / 8.4565482 ;
LIVE_LYMPH_COUNT = LIVE_LYMPH_COUNT / 7044.02 ;
CD4_CD38_ = CD4_CD38_ / 12.1331635 ;
CD4_CD28_ = CD4_CD28_ / 10.0446624 ;
CD4_CD45RA_CD28_CD57__AS_CD4 = CD4_CD45RA_CD28_CD57__AS_CD4 / 5.3288475 ;
CD4_CD57_ = CD4_CD57_ / 12.9488516 ;
cd8_mnas_mesa_final_CD8_ = cd8_mnas_mesa_final_CD8_ / 9.3385893 ;
CD8_CD45RA_ = CD8_CD45RA_ / 14.6668267 ;
CD8_CD45RO_ = CD8_CD45RO_ / 10.6215264 ;
CD8_CD28_CD57_ = CD8_CD28_CD57_ / 15.8827921 ;
LIVE_LYMPH_COUNT_8 = LIVE_LYMPH_COUNT_8 / 7381.23 ;
CD8_CD38_ = CD8_CD38_ / 12.1970917 ;
CD8_CD28_ = CD8_CD28_ / 15.9305801 ;
CD8_CD45RA_CD28_CD57__AS_CD8 = CD8_CD45RA_CD28_CD57__AS_CD8 / 14.2740251 ;
CD8_CD57_ = CD8_CD57_ / 15.4380623 ;
cd3_ = cd3_ / 13.6970536 ;
cd3_gd_ = cd3_gd_ / 4.0324039 ;
NK_lymphs = NK_lymphs / 5.6925374 ;
B_CELLS = B_CELLS / 7.3817656 ;
cd4_cd25_ = cd4_cd25_ / 7.1005486 ;
cd6_cd127_cd4_cd25__as__lymphs = cd6_cd127_cd4_cd25__as__lymphs / 0.5234053 ;
cd4_cd25_cd6dim = cd4_cd25_cd6dim / 3.7634147 ;
CD14_CD16_ = CD14_CD16_ / 12.8157347 ;
CD14_CD16_ = CD14_CD16_ / 4.9169505 ;
XX = XX / 3.2611816 ;
mesa_th1_final_CD4_ = mesa_th1_final_CD4_ / 13.5738544 ;
mesa_th1_final_CD8_ = mesa_th1_final_CD8_ / 8.3438174 ;
th1_as_cd4 = th1_as_cd4 / 8.9953262 ;
th2_as_cd4 = th2_as_cd4 / 1.7477505 ;
th17_as_cd4 = th17_as_cd4 / 1.4328386 ;
cd8IFNas_cd8 = cd8IFNas_cd8 / 17.8840879 ;
cd8il4_as_cd8 = cd8il4_as_cd8 / 4.9215664 ;
cd8il17_as_cd8 = cd8il17_as_cd8 / 5.7672104 ;

CD14_CD16_3 = CD14_CD16_2 / 10.2084227 ;
CD14_CD16_3 = CD14_CD16_2 / 7.1003813 ;
XX3 = XX2 / 7.5327375 ;

```

```

ace=max(ace4c,aced4c);
ccb=ccb4c;
diur=max(aced4c, diur4c, betad4c, vasod4c);
beta=max(betad4c, beta4c);
vaso=max(vaso4c, vasod4c);
any_ah=max(ace,ccb,diur,beta,vaso);
if any_ah=1 then sbp_adj=sbp+10;
else sbp_adj=sbp;
run;

```

```

data five;
merge check (in=in) lib.Mesae5_finallabel_20141107 (keep=idno e15dyc age5c age1c gender1 race1c sbp5c
cursmk5 dm035c curalc5 bmi5c dbp5c exercm5c);

```

```

by idno;
if ina;
sbp=sbp5c;
dbp=dbp5c;
time=e15dyc/365;
age=age5c;
group=1;
ace=max(ace5c,aced5c);
ccb=ccb5c;
diur=max(aced5c, diur5c, betad5c, vasod5c);
beta=max(betad5c, beta5c);
vaso=max(vaso5c, vasod5c);
any_ah=max(ace,ccb,diur,beta,vaso);
if any_ah=1 then sbp_adj=sbp+10;
else sbp_adj=sbp;cd4_mnas_mesa_final_CD4_ = cd4_mnas_mesa_final_CD4_ / 11.0148293 ;
CD4_CD45RA_ = CD4_CD45RA_ / 12.0481371 ;
CD4_CD45RO_ = CD4_CD45RO_ / 13.4133922 ;
CD4_CD28_CD57_ = CD4_CD28_CD57_ / 8.4565482 ;
LIVE_LYMPH_COUNT = LIVE_LYMPH_COUNT / 7044.02 ;
CD4_CD38_ = CD4_CD38_ / 12.1331635 ;
CD4_CD28_ = CD4_CD28_ / 10.0446624 ;
CD4_CD45RA_CD28_CD57__AS_CD4 = CD4_CD45RA_CD28_CD57__AS_CD4 / 5.3288475 ;
CD4_CD57_ = CD4_CD57_ / 12.9488516 ;
cd8_mnas_mesa_final_CD8_ = cd8_mnas_mesa_final_CD8_ / 9.3385893 ;
CD8_CD45RA_ = CD8_CD45RA_ / 14.6668267 ;
CD8_CD45RO_ = CD8_CD45RO_ / 10.6215264 ;
CD8_CD28_CD57_ = CD8_CD28_CD57_ / 15.8827921 ;
LIVE_LYMPH_COUNT_8 = LIVE_LYMPH_COUNT_8 / 7381.23 ;
CD8_CD38_ = CD8_CD38_ / 12.1970917 ;
CD8_CD28_ = CD8_CD28_ / 15.9305801 ;
CD8_CD45RA_CD28_CD57__AS_CD8 = CD8_CD45RA_CD28_CD57__AS_CD8 / 14.2740251 ;
CD8_CD57_ = CD8_CD57_ / 15.4380623 ;
cd3_ = cd3_ / 13.6970536 ;
cd3_gd_ = cd3_gd_ / 4.0324039 ;
NK_lymphs = NK_lymphs / 5.6925374 ;
B_CELLS = B_CELLS / 7.3817656 ;
cd4_cd25_ = cd4_cd25_ / 7.1005486 ;
cd6_cd127_cd4_cd25__as__lymphs = cd6_cd127_cd4_cd25__as__lymphs / 0.5234053 ;
cd4_cd25_cd6dim = cd4_cd25_cd6dim / 3.7634147 ;
CD14_CD16_ = CD14_CD16_ / 12.8157347 ;
CD14_CD16_ = CD14_CD16_ / 4.9169505 ;
XX = XX / 3.2611816 ;
mesa_th1_final_CD4_ = mesa_th1_final_CD4_ / 13.5738544 ;
mesa_th1_final_CD8_ = mesa_th1_final_CD8_ / 8.3438174 ;
th1_as_cd4 = th1_as_cd4 / 8.9953262 ;
th2_as_cd4 = th2_as_cd4 / 1.7477505 ;
th17_as_cd4 = th17_as_cd4 / 1.4328386 ;
cd8IFNas_cd8 = cd8IFNas_cd8 / 17.8840879 ;
cd8il4_as_cd8 = cd8il4_as_cd8 / 4.9215664 ;
cd8il17_as_cd8 = cd8il17_as_cd8 / 5.7672104 ;

CD14_CD16_3 = CD14_CD16_2 / 10.2084227 ;
CD14_CD16_3 = CD14_CD16_2 / 7.1003813 ;
XX3 = XX2 / 7.5327375 ;
run;

```

```
data a;
set one two;
run;

proc means;
run;

data b;
set a three;
run;

data c;
set b four;
run;

data d (drop=exercm1c educ1 college);;
set c five;
if sbp ne .;

if RACE1C=1 then r1=1;
else r1=0;
if RACE1C=2 then r2=1;
else r2=0;
if RACE1C=3 then r3=1;
else r3=0;
if RACE1C=4 then r4=1;
else r4=0;

if gender1=1 then male=1;
else male=0;

age2=age1c/9.8305287;
time2=time/3.1773682;

monocyte1= CD14__CD16_ /12.36 ;
monocyte2=CD14_CD16_ /4.32 ;
monocyte3=xx/3.29 ;

age_sq=age*age;

chinese = r2;
black=r3;
hispanic = r4;

cursmk=max(cursmk1, cursmk2, cursmk3, cursmk4, cursmk5);
dm03=max(dm031c, dm032c, dm033c, dm034c, dm035c);
curalc=max(curalc1r, curalc2, curalc3, curalc4, curalc5);
  curalc_new=max(add_alc, curalc2, curalc3, curalc4, curalc5);
curalc_old=max(curalc1, curalc2, curalc3, curalc4, curalc5);
bmi=max(bmi1c, bmi2c, bmi3c, bmi4c, bmi5c);
exercm=max(exercm1c,exercm2c,exercm3c,exercm4c,exercm5c);

if dm03 >1 then diabetes=1;
else diabetes = 0;
```

```
mesa_th1_final_CD8_SD=mesa_th1_final_CD8_/.8.849411;
mesa_th1_final_CD4_SD= mesa_th1_final_CD4_/.12.6115761;
if cursmk=. then cursmk=0;
run;
proc means;
var cursmk cursmk1 cursmk2 cursmk3 cursmk4 cursmk5 exercm diabetes;
run;

proc freq;
tables dm03 ;

run;

proc freq;
tables race1c;
where time=0;
run;

data pp (keep=idno exercm1c educ1 college add_alc);
merge check (in=ina) one;
by idno;
if ina;

if educ1>6 then college=1;
else college=0;

run;

proc means;
run;

proc sort data=d;
by idno;
run;

data d3;
merge pp d (drop=add_alc);
by idno;

run;

proc means;
run;

proc sort data=d3;
by idno;
run;

data e;
merge d3 (in=ina) quat(in=inp);
by idno;
if ina;
if inp;
```

```
ratio=cd4_cd25_/_th17_as__cd4;
run;

proc means data=e;
var cursmk cursmk1 cursmk2 cursmk3 cursmk4 cursmk5 samp_weight;
run;

proc means;
var age male chinese black hispanic cursmk sbp dbp time
diabetes
curalc
bmi cd4_mnas_mesa_final_CD4_
CD4_CD45RA_
CD4_CD45RO_
CD4_CD28_CD57_
CD4_CD38_
CD4_CD28_
CD4_CD45RA_CD28_CD57__AS_CD4
CD4_CD57_
cd8_mnas_mesa_final_CD8_
CD8_CD45RA_
CD8_CD45RO_
CD8_CD28_CD57_
CD8_CD38_
CD8_CD28_
CD8_CD45RA_CD28_CD57__AS_CD8
CD8_CD57_
cd3_
cd3_gd_
NK_lymphs
B_CELLS
cd4_cd25_
cd6_cd127_cd4_cd25__as___lymphs
cd4_cd25_cd6dim
CD14_CD16_
CD14_CD16_
xx
mesa_th1_final_CD4_
mesa_th1_final_CD8_
th1_as_cd4
th2_as_cd4
th17_as_cd4
cd8IFNas_cd8
cd8il4_as_cd8
cd8il17_as_cd8 exercm1c exercm
;
run;

data d2 (keep =idno study age male chinese black hispanic cursmk sbp dbp time
diabetes
curalc
bmi cd4_mnas_mesa_final_CD4_
```

```

CD4_CD45RA_
CD4_CD45R0_
CD4_CD28_CD57_
CD4_CD38_
CD4_CD28_
CD4_CD45RA_CD28_CD57_AS_CD4
CD4_CD57_
cd8_mnas_mesa_final_CD8_
CD8_CD45RA_
CD8_CD45R0_
CD8_CD28_CD57_
CD8_CD38_
CD8_CD28_
CD8_CD45RA_CD28_CD57_AS_CD8
CD8_CD57_
cd3_
cd3_gd_
NK_lymphs
B_CELLS
cd4_cd25_
cd6_cd127_cd4_cd25_as_lymphs
cd4_cd25_cd6dim
CD14_CD16_
CD14_CD16_
xx
mesa_th1_final_CD4_
mesa_th1_final_CD8_
th1_as_cd4
th2_as_cd4
th17_as_cd4
cd8IFNas_cd8
cd8il4_as_cd8
cd8il17_as_cd8 );
set e;

run;

/* Third, now that the data is assembled, automate a series of mixed models to estimate mean
Systolic blood pressure across 10 years of follow-up */

data table;
run;
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = ratio age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv
bmi diabetes log_cmv

```

```
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd4_mnas_mesa_final_CD4_ age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi diabetes log_cmv

/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD4_CD45RA_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
```

```
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj =CD4_CD45R0_
 age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
 / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD4_CD28_CD57_
 age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
 / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;
```

```
if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj =CD4_CD38_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD4_CD28_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;
```

```
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD4_CD45RA_CD28_CD57_AS_CD4
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;
```

```
data table;
set table sol2;
run;
```

```
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD4_CD57_
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv
```

```
bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;
```

```
ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;
```

```
data table;
set table sol2;
run;
```

```
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd8_mnas_mesa_final_CD8_
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv
```

```
bmi  
 / cl ;  
random Intercept/subject=idno;  
repeated /subject=idno; weight samp_weight;  
  
ods output solutionF=sol;  
run;
```

```
data sol2;  
set sol;  
  
if _N_ = 2;  
run;
```

```
data table;  
set table sol2;  
run;
```

```
proc mixed data=e METHOD=REML EMPIRICAL;  
class idno;  
model sbp_adj =CD8_CD45RA_  
 age male r2 r3 r4 cursmk  
exercm1c college diabetes log_cmv
```

```
bmi  
 / cl ;  
random Intercept/subject=idno;  
repeated /subject=idno; weight samp_weight;
```

```
ods output solutionF=sol;  
run;
```

```
data sol2;  
set sol;
```

```
if _N_ = 2;  
run;
```

```
data table;  
set table sol2;  
run;
```

```
proc mixed data=e METHOD=REML EMPIRICAL;  
class idno;  
model sbp_adj = CD8_CD45RO_  
 age male r2 r3 r4 cursmk  
exercm1c college diabetes log_cmv
```

```
bmi  
 / cl ;  
random Intercept/subject=idno;  
repeated /subject=idno; weight samp_weight;
```

```
ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD8_CD28_CD57_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD8_CD38_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;
```

```
if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD8_CD28_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD8_CD45RA_CD28_CD57__AS_CD8
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
```

```
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD8_CD57_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj =cd3_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd3_gd_
age male r2 r3 r4 cursmk
```

```
exercm1c college diabetes log_cmv

bmi
 / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = NK_lymphs
    age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
 / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj =B_CELLS
    age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
```

```
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj =cd4_cd25_

    age    male r2 r3 r4  cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd6_cd127_cd4_cd25_as_lymphs

    age    male r2 r3 r4  cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
```

```
repeated /subject=idno; weight samp_weight;  
  
ods output solutionF=sol;  
run;  
  
data sol2;  
set sol;  
  
if _N_ = 2;  
run;  
  
data table;  
set table sol2;  
run;  
proc mixed data=e METHOD=REML EMPIRICAL;  
class idno;  
model sbp_adj = cd4_cd25_cd6dim  
  
    age male r2 r3 r4 cursmk  
exercm1c college diabetes log_cmv  
  
bmi  
    / cl ;  
random Intercept/subject=idno;  
repeated /subject=idno; weight samp_weight;  
  
ods output solutionF=sol;  
run;  
  
data sol2;  
set sol;  
  
if _N_ = 2;  
run;  
  
data table;  
set table sol2;  
run;  
proc mixed data=e METHOD=REML EMPIRICAL;  
class idno;  
model sbp_adj = CD14_CD16_  
  
    age male r2 r3 r4 cursmk  
exercm1c college diabetes log_cmv  
  
bmi  
    / cl ;  
random Intercept/subject=idno;  
repeated /subject=idno; weight samp_weight;  
  
ods output solutionF=sol;  
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14_CD16_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = xx

age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;
```

```
data table;
set table sol2;
run;
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = mesa_th1_final_CD4_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = mesa_th1_final_CD8_
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
```

```
class idno;
model sbp_adj = th1_as_cd4

age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;
ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;
```

```
data table;
set table sol2;
run;
```

```
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj =th2_as_cd4
```

```
age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv
```

```
bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;
ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;
```

```
data table;
set table sol2;
run;
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = th17_as_cd4
```

```
age male r2 r3 r4 cursmk
```

```
exercm1c college diabetes log_cmv

bmi
 / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;
ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd8IFNas_cd8
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
 / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd8il4_as_cd8
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
 / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;
```

```
ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd8il17_as_cd8
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv
bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14_CD16_2
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv
/ cl ;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
```

```
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj= xx2
    age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;

repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14_CD16_2
    age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

/ cl ;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;
```

```
data table;
set table sol2;
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14_CD16_3
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

/ cl ;

repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;
```

```
proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj= xx3
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv

bmi
/ cl ;

repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;
```

```
data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
```

```
run;

proc mixed data=e METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14_CD16_3
  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv
  / cl ;
repeated /subject=idno;  weight samp_weight;

ods output solutionF=sol;
run;

data sol2;
set sol;

if _N_ = 2;
run;

data table;
set table sol2;
run;

proc print data=table;
var Effect Estimate    Lower Upper Probt;
run;

/* Fourth, introduce some revised variables based on Vermont lab variable development */

options nolabel;

data wray;
set lib.Mesasupplementaldata20180712;

idno=mesaid;

if gdpcd3< 0 then gdpcd3=.;
if CD14_CD16_PCTCD14<0 then CD14_CD16_PCTCD14=.;
if CD14_CD16_PCTCD14 <0 then CD14_CD16_PCTCD14=.;
if CD14DIMCD16__PCTCD14 <0 then CD14DIMCD16__PCTCD14=.;
if cd_cd25_cd127_cd6_pctcd4 < 0  then cd_cd25_cd127_cd6_pctcd4=.*;

run;
```

```
proc means;
run;

proc sort data=wray;
by idno;
run;
data new;
merge e wray;
by idno;
gdptcd3=gdptcd3/6.1365406;
cd_cd25_cd127_cd6_pctcd42=cd_cd25_cd127_cd6_pctcd4/1.1196273;
CD14_CD16_PCTCD142 =CD14_CD16_PCTCD14 /10.2396366 ;
CD14_CD16_PCTCD142 =CD14_CD16_PCTCD14/7.0487664 ;
CD14DIMCD16_PCTCD142 =CD14DIMCD16_PCTCD14/7.5246573 ;
run;
```

```
proc means;
run;
data table;
run;
```

```
proc mixed data=new METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = gdptcd3
    age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv bmi
/ cl ;

repeated /subject=idno; weight samp_weight;
```

```
ods output solutionF=sol;
run;
```

```
proc mixed data=new METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = cd_cd25_cd127_cd6_pctcd42
    age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv bmi
/ cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;
```

```
proc mixed data=new METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14_CD16_PCTCD142

  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv bmi

bmi
  / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

proc mixed data=new METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14_CD16_PCTCD142

  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv bmi

  / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

proc mixed data=new METHOD=REML EMPIRICAL;
class idno;
model sbp_adj = CD14DIMCD16_PCTCD142

  age male r2 r3 r4 cursmk
exercm1c college diabetes log_cmv bmi

  / cl ;
random Intercept/subject=idno;
repeated /subject=idno; weight samp_weight;

ods output solutionF=sol;
run;

/* This is the complete data assembly and modeling code for the primary results of the paper */
```