Suplementary Material 1: Code to Reproduce Analysis and Plots

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Introduction

The aim of this document is to display the R code needed the reproduce the findings of the main text. This documents needs the twinR package to be installed to run.

```
#cleanup memory
gcstuff <- gc(verbose=FALSE); rm(gcstuff);
```

```
#get last birth adding function
source("./R/last_birth.R")

#simplified twinR summary tables
source("./R/twinR_summary.R")

#fix twinR compute predictions to do prediction with no lambda  as well
source("./R/twinR_predictions.R")

#simple convenience functions
source("./R/utils.R")
```

```
## Identify number of CPU cores available for parallel computing,
## note: using a large number may lead RAM to max out, so you may have to adjust
## that according to your infrastructure:
nb_cores <- min(c(50L, parallel::detectCores() - 1))

## Set option in spaMM:
spaMM::spaMM.options(nb_cores = nb_cores)
```

```
## Registered S3 methods overwritten by 'registry':
##   method               from
##   print.registry_field proxy
##   print.registry_entry proxy
```

Data Import Estonia

The Estonian dataset has been formatted to include the same columns as *the data_births_all* dataset from the **twinR** package. The only difference is that the columns *pop* and *monthly* are excluded as these are constant.

```r
#Import and preproccess Estonian Data

data_births_monthly_EE <- readRDS("./data/data_births_all_EE.rds")

#the twinR package expects population to be present
data_births_monthly_EE$pop <- "Estonia"

## Expand the birth level data for the fit of statistical models:
data_births_monthly_EE <- twinR::expand_data(data_births_monthly_EE)

data_births_monthly_EE <- add_last_birth(data_births_monthly_EE)

data_births_monthly_EE_not_last <- data_births_monthly_EE[!data_births_monthly_EE$last,]

#make the aggregates
dmm_EE <- twinR::aggregate_data(data_births_monthly_EE)
dmm_EE$prob_twin <- dmm_EE$twin_total / dmm_EE$births_total

dmm_EE_nl <- twinR::aggregate_data(data_births_monthly_EE_not_last)
dmm_EE_nl$prob_twin <- dmm_EE_nl$twin_total / dmm_EE_nl$births_total
```

Data Import 9 Other European Populations

```r
##Import and pre-proccess twinR package data

## Filter the raw data to only keep data with monthly resolution:
data_births_monthly <- twinR::filter_data(twinR::data_births_all)

## Expand the birth level data for the fit of statistical models:
data_births_monthly <- twinR::expand_data(data_births_monthly)

data_births_monthly <- add_last_birth(data_births_monthly)
data_births_monthly_not_last <- data_births_monthly[!data_births_monthly$last,]

dmm_orig <- twinR::aggregate_data(data_births_monthly)
dmm_orig$prob_twin <- dmm_orig$twin_total /dmm_orig$births_total

dmm_orig_nl <- twinR::aggregate_data(data_births_monthly_not_last)
dmm_orig_nl$prob_twin <- dmm_orig_nl$twin_total /dmm_orig_nl$births_total
```

```r
#compared to twinR original add data on :
#-age at first birth (AFB)
#-quantiles range mother birth year
#-quantiles range offspring birth year
#-mean + SE total births
all_tbls <- rbind(build_data_summary.table(data_births_monthly),
                  build_data_summary.table(data_births_monthly_not_last),
                  build_data_summary.table(data_births_monthly_EE),
                  build_data_summary.table(data_births_monthly_EE_not_last))
```

```
#some labels
estLab <- "Estonian"
westLab <- "9 other European"
```

```
all_tbls$Dataset  <- rep(c("All births", "Without last birth"),2)
all_tbls$Populations  <- rep(c(westLab, estLab),each=2)
all_tbls <- as.data.frame(all_tbls)
row.names(all_tbls) <- paste0(all_tbls$Populations, " populations ",
                              tolower(all_tbls$Dataset))
knitr::kable(t(all_tbls),
             caption = paste0("Summary data on the Estonian and other ",
                              "European populations for both ",
                              "all births and wihout last birth for same mothers"))
```

Table 1: Summary data on the Estonian and other European populations for both all births and wihout last birth for same mothers

	9 other European populations all births	9 other European populations without last birth	Estonian populations all births	Estonian populations without last birth
Populations	9 other European	9 other European	Estonian	Estonian
Dataset	All births	Without last birth	All births	Without last birth
Maternal birth period	1700-1899	1700-1899	1850-1899	1850-1899
1/4 and 3/4 quantiles for maternal birth period	1786-1847	1785-1847	1873-1890	1872-1890
Age at first birth (mean-SE)	24.68-0.013	24.36-0.014	25.06-0.007	24.5-0.0075
Mothers	21290	18520	125575	98183
Non-twinners	19656	17344	119511	94386
Twinners	1634	1176	6064	3797
Twinner rate (‰)	76.75	63.50	48.29	38.67
Offspring birth period	1720-1945	1720-1941	1868-1948	1868-1943
1/4 and 3/4 quantiles for offspring birth period	1817-1879	1815-1877	1903-1921	1901-1918
Births	105833	84543	417418	291843
Singleton births	104069	83276	411026	287874
Twin births	1764	1267	6392	3969
Twinning rate (‰)	16.67	14.99	15.31	13.60
Total births (min-median-max)	1-7-18	1-6-17	1-4-16	1-4-15
Total births (mean-SE)	6.71-0.0089	6.15-0.0093	4.75-0.0039	4.36-0.0044

Fitting models

```
# import the function to do model fit and predictions
source("./R/fit_models.R")
```

Full Data

```
## Estonia - mother level data
formula <- "cbind(twin_total, singleton_total) ~ 1 + births_total"
dmm_EE_fit <- fitPredictions(dmm_EE, formula, predict = T)
```

```
## Warning in fitPredictions(dmm_EE, formula, predict = T): Pre-computed fit returned from file:
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_totaldmm_EE_fit.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions returne
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_totaldmm_EEdata_fig.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dmm_EE_fit$fit))
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-4.15	0.0269	-154
	births_total	-0.00183	0.00502	-0.364
response family	binomial with logit link			
fit info	number of model parameters	2		
	marginal log Likelihood	-24446		
	marginal AIC	48896		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	125575		

```
## Estonia - birth level data
formula <- "twin ~ 1 + poly(cbind(age, parity), 3) + (1|maternal_id)"
dbm_EE_fit <- fitPredictions(data_births_monthly_EE, formula, nb_boot = 0)
```

```
## Warning in fitPredictions(data_births_monthly_EE, formula, nb_boot = 0): Pre-computed fit returned fi
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)data_births_monthly_EE_fit.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions returne
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)data_births_monthly_EEdata_fig.r
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dbm_EE_fit$fit))
```

```
## [one-time computation of covariance matrix, which may be slow]
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-4.23	0.0288	-147
	poly(cbind(age, parity), 3)1.0	125	23.3	5.34
	poly(cbind(age, parity), 3)2.0	-116	14.2	-8.14

Type	Variable	Value	Cond. SE	t-value
	poly(cbind(age, parity), 3)3.0	-68	14.9	-4.55
	poly(cbind(age, parity), 3)0.1	44	36	1.23
	poly(cbind(age, parity), 3)1.1	6071	20377	0.298
	poly(cbind(age, parity), 3)2.1	13476	14544	0.927
	poly(cbind(age, parity), 3)0.2	-6.92	26.9	-0.257
	poly(cbind(age, parity), 3)1.2	-11971	14297	-0.837
	poly(cbind(age, parity), 3)0.3	-12	13	-0.927
random effects	variance between name	0.524		
response family	binomial with logit link			
fit info	number of model parameters	11		
	marginal log Likelihood	-32715		
	marginal AIC	65452		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	417418		

```
## TwinR - mother level data
formula <- "cbind(twin_total, singleton_total) ~ 1 + births_total + (1|pop)"
dmm_orig_fit <- fitPredictions(dmm_orig, formula, predict=T)
```

```
## Warning in fitPredictions(dmm_orig, formula, predict = T): Pre-computed fit returned from file:
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_total+(1_x_pop)dmm_orig_fit.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions returne
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_total+(1_x_pop)dmm_origdata_fig.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dmm_orig_fit$fit))
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-3.83	0.104	-37
	births_total	-0.0338	0.00864	-3.92
random effects	variance between name	0.0556		
response family	binomial with logit link			
fit info	number of model parameters	3		
	marginal log Likelihood	-5993		
	marginal AIC	11992		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	21290		

```
## TwinR - birth level data
formula <- "twin ~ 1 + poly(cbind(age, parity), 3) + (1|maternal_id) + (1|pop)"
dbm_orig_fit <- fitPredictions(data_births_monthly, formula, nb_boot = 0)
```

```
## Warning in fitPredictions(data_births_monthly, formula, nb_boot = 0): Pre-computed fit returned from
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)+(1_x_pop)data_births_monthly_fi
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions returne
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)+(1_x_pop)data_births_monthlydat
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dbm_orig_fit$fit))
```

```
## [one-time computation of covariance matrix, which may be slow]
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-4.1	0.113	-36
	poly(cbind(age, parity), 3)1.0	74	31	2.37
	poly(cbind(age, parity), 3)2.0	-61	17.2	-3.55
	poly(cbind(age, parity), 3)3.0	-47	16.4	-2.87
	poly(cbind(age, parity), 3)0.1	-0.936	40	-0.0233
	poly(cbind(age, parity), 3)1.1	-4006	11890	-0.337
	poly(cbind(age, parity), 3)2.1	7710	8669	0.889
	poly(cbind(age, parity), 3)0.2	19	27.3	0.694
	poly(cbind(age, parity), 3)1.2	-4380	8121	-0.539
	poly(cbind(age, parity), 3)0.3	-18.6	14.1	-1.32
random effects	variance between name	0.485		
	variance between name	0.0571		
response family	binomial with logit link			
fit info	number of model parameters	12		
	marginal log Likelihood	-8828		
	marginal AIC	17681		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	105833		

No Last Births Data

```
## Estonia
formula <- "cbind(twin_total, singleton_total) ~ 1 + births_total"
dmm_EE_nl_fit <- fitPredictions(dmm_EE_nl, formula, predict = T)
```

```
## Warning in fitPredictions(dmm_EE_nl, formula, predict = T): Pre-computed fit returned from file:
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_totaldmm_EE_nl_fit.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions returne
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_totaldmm_EE_nldata_fig.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dmm_EE_nl_fit$fit))
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-4.36	0.0333	-131
	births_total	0.0179	0.00655	2.73

Type	Variable	Value	Cond. SE	t-value
response family	binomial with logit link			
fit info	number of model parameters	2		
	marginal log Likelihood	-15893		
	marginal AIC	31790		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	98183		

```
## Estonia - birth level data
formula <- "twin ~ 1 + poly(cbind(age, parity), 3) + (1|maternal_id)"
dbm_EE_nl_fit <- fitPredictions(data_births_monthly_EE_not_last, formula,
                                predict = T, nb_boot = 0)
```

```
## Warning in fitPredictions(data_births_monthly_EE_not_last, formula, predict = T, : Pre-computed fit
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)data_births_monthly_EE_not_last
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions return
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)data_births_monthly_EE_not_last
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dbm_EE_nl_fit$fit))
```

```
## [one-time computation of covariance matrix, which may be slow]
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-4.31	0.0365	-118
	poly(cbind(age, parity), 3)1.0	119	22.5	5.29
	poly(cbind(age, parity), 3)2.0	-34	14.5	-2.33
	poly(cbind(age, parity), 3)3.0	-21.9	14	-1.57
	poly(cbind(age, parity), 3)0.1	54	38	1.44
	poly(cbind(age, parity), 3)1.1	-11865	17926	-0.662
	poly(cbind(age, parity), 3)2.1	9736	11628	0.837
	poly(cbind(age, parity), 3)0.2	19.6	29	0.671
	poly(cbind(age, parity), 3)1.2	-11242	11738	-0.958
	poly(cbind(age, parity), 3)0.3	-3.45	12.9	-0.268
random effects	variance between name	0.487		
response family	binomial with logit link			
fit info	number of model parameters	11		
	marginal log Likelihood	-20820		
	marginal AIC	41662		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	291843		

```
## TwinR
formula <- "cbind(twin_total, singleton_total) ~ 1 + births_total + (1|pop)"
dmm_orig_nl_fit <- fitPredictions(dmm_orig_nl, formula, predict = T)
```

```
## Warning in fitPredictions(dmm_orig_nl, formula, predict = T): Pre-computed fit returned from file:
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_total+(1_x_pop)dmm_orig_nl_fit.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions returne
## ./data/predictions/cbind(twin_total,singleton_total)~1+births_total+(1_x_pop)dmm_orig_nldata_fig.rds
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dmm_orig_nl_fit$fit))
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-4.14	0.119	-35
	births_total	-0.000955	0.0108	-0.0881
random effects	variance between name	0.0691		
response family	binomial with logit link			
fit info	number of model parameters	3		
	marginal log Likelihood	-4491		
	marginal AIC	8988		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	18520		

```
## TwinR - birth level data
formula <- "twin ~ 1 + poly(cbind(age, parity), 3) + (1|maternal_id) + (1|pop)"
dbm_orig_nl_fit <- fitPredictions(data_births_monthly_not_last, formula, nb_boot = 0)
```

```
## Warning in fitPredictions(data_births_monthly_not_last, formula, nb_boot = 0): Pre-computed fit retu
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)+(1_x_pop)data_births_monthly_n
##  If you want to re-run this step delete the file or change the saveDir!
```

```
## Warning in get_predictions(predDataFname, fit, dataset, args, save): Pre-computed predictions returne
## ./data/predictions/twin~1+poly(cbind(age,parity),3)+(1_x_maternal_id)+(1_x_pop)data_births_monthly_n
##  If you want to re-run this step delete the file or change the saveDir!
```

```
knitr::kable(build_fit_summary.table(dbm_orig_nl_fit$fit))
```

```
## [one-time computation of covariance matrix, which may be slow]
```

Type	Variable	Value	Cond. SE	t-value
fixed effects	(Intercept)	-4.24	0.127	-33
	poly(cbind(age, parity), 3)1.0	86	31	2.75
	poly(cbind(age, parity), 3)2.0	-35	18	-1.94
	poly(cbind(age, parity), 3)3.0	-22.8	15.9	-1.43
	poly(cbind(age, parity), 3)0.1	-23.1	42	-0.548
	poly(cbind(age, parity), 3)1.1	4850	11442	0.424
	poly(cbind(age, parity), 3)2.1	2440	7667	0.318
	poly(cbind(age, parity), 3)0.2	7.32	30	0.248
	poly(cbind(age, parity), 3)1.2	1548	7323	0.211
	poly(cbind(age, parity), 3)0.3	-11.9	13	-0.909

Type	Variable	Value	Cond. SE	t-value
random effects	variance between name	0.536		
	variance between name	0.0678		
response family	binomial with logit link			
fit info	number of model parameters	12		
	marginal log Likelihood	-6480		
	marginal AIC	12985		
	conditional AIC (cAIC)			
data info	number of fitted observations (N)	84543		

Plots

```
library(ggplot2)
#some nice colors
bc <- c("azure4","purple4", "black", "navy", "darkgoldenrod2", "springgreen3", "gray")

#use new base theme that displays also grid lines
source("./R/twinR_theme.R")
```

Fig 1a: Estonian vs TwinR Full Data

```
fig2_EE_plot_data <- dmm_EE_fit$results
fig2_orig_plot_data <- dmm_orig_fit$results
```

```
infoTxt <- "model prediction with 95% CI and data mean SE"

fig2_ext_orig <- ggplot() +
  geom_line(data=fig2_EE_plot_data,
              aes(y = estimate,  x=births_total, color=estLab),  size = 1) +
    stat_summary(data=dmm_EE[dmm_EE$births_total <17, ],
                 aes(x=births_total, y=prob_twin, color=estLab, fill = estLab),
                 alpha=1,
                 position = position_nudge(x = -0.1),
                 fun.data=mean_se) +
    geom_ribbon(data=fig2_EE_plot_data,
                aes(y = estimate,  x=births_total, ymin = lwr, ymax = upr,
                    color=estLab, fill = estLab),
                alpha = 0.3) +
    geom_line(data=fig2_orig_plot_data,
              aes(y = estimate,  x=births_total, color=westLab),  size = 1) +
    stat_summary(data=dmm_orig[dmm_orig$births_total <19, ],
                 aes(x=births_total, y=prob_twin,
                     color=westLab, fill=westLab),
                 alpha=1,
                 shape = 1,
                 position = position_nudge(x = 0.1),
                 fun.data=mean_se) +
    geom_ribbon(data=fig2_orig_plot_data,
                aes(y = estimate,  x=births_total, ymin = lwr, ymax = upr,
```

```
                    fill=westLab),
                alpha = 0.1) +
    ggplot2::scale_x_continuous(breaks = 1:18) +
    ggplot2::scale_y_continuous(breaks = seq(0,0.03, by=0.005)) +
    ggplot2::coord_cartesian() +
    labs(subtitle = paste0("(a) All births, ", infoTxt),
         y="Per-birth twin. prob.",
         x="Maternal total births")
p2 <- fig2_ext_orig + base_theme(larger=8) + scale_color_manual(values=bc) +
  scale_fill_manual(values=bc) + guides(color="none") + labs(fill = "population")

p2
```

```
## Warning: Removed 1 rows containing missing values (geom_segment).
```

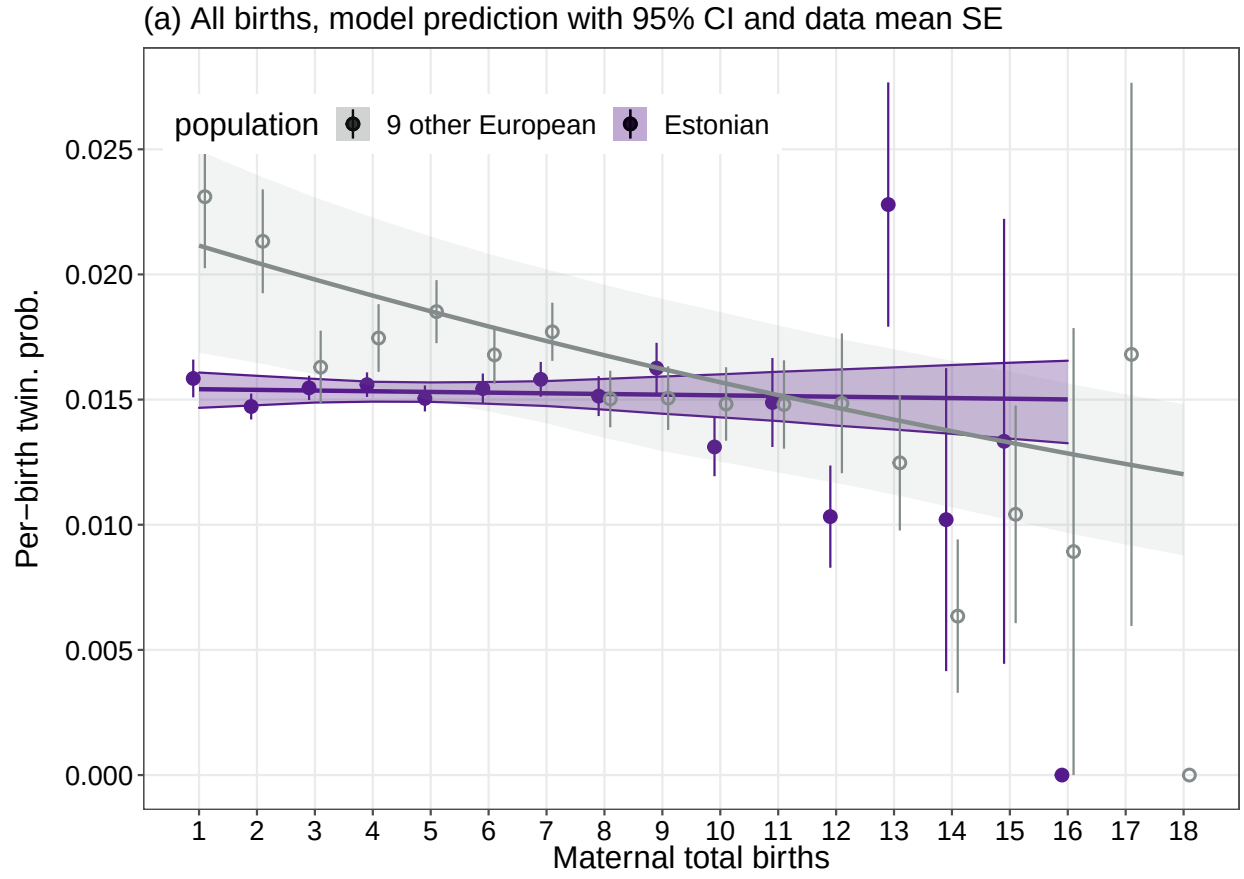


Fig 1b: Estonian vs Others No Last Birth

```
fig2_EE_plot_data_nl <- dmm_EE_nl_fit$results
fig2_EE_plot_data_nl$births_total <- fig2_EE_plot_data_nl$births_total + 1
fig2_orig_plot_data_nl <- dmm_orig_nl_fit$results
fig2_orig_plot_data_nl$births_total <- fig2_orig_plot_data_nl$births_total + 1
```

```
dmm_EE_nl_plot <- dmm_EE_nl
dmm_orig_nl_plot <- dmm_orig_nl
dmm_EE_nl_plot$births_total <- dmm_EE_nl_plot$births_total + 1
dmm_orig_nl_plot$births_total <- dmm_orig_nl_plot$births_total + 1
```

```
fig2_ext_orig <- ggplot() +
  geom_line(data=fig2_EE_plot_data_nl,
              aes(y = estimate,  x=births_total, color=estLab),  size = 1) +
    stat_summary(data=dmm_EE_nl_plot,
                 aes(x=births_total, y=prob_twin, color=estLab, fill = estLab),
                 alpha=1,
                 fun.data=mean_se,
                 position = position_nudge(x = -0.1)) +
    geom_ribbon(data=fig2_EE_plot_data_nl,
                aes(y = estimate, x=births_total, ymin = lwr, ymax = upr,
                    color=estLab, fill = estLab),
                alpha = 0.3) +
    geom_line(data=fig2_orig_plot_data_nl,
              aes(y = estimate,  x=births_total, color=westLab),  size = 1) +
    stat_summary(data=dmm_orig_nl_plot,
                 aes(x=births_total, y=prob_twin,
                     color=westLab, fill=westLab),
                 alpha=1,
                 shape = 1,
                 fun.data=mean_se,
                 position = position_nudge(x = 0.1)) +
    geom_ribbon(data=fig2_orig_plot_data_nl,
                aes(y = estimate,  x=births_total, ymin = lwr, ymax = upr,
                    fill=westLab),
                alpha = 0.1) +
    ggplot2::scale_x_continuous(breaks = 1:18, limits = c(1,NA)) +
    ggplot2::scale_y_continuous(breaks = seq(0,0.03, by=0.005)) +
    ggplot2::coord_cartesian(ylim=c(0,0.03)) +
    labs(subtitle = paste0("(b) Without last birth, ", infoTxt),
         y="Per-birth twin. prob.",
         x="Maternal total births")
p3 <- fig2_ext_orig + base_theme(larger=8) + scale_color_manual(values=bc) +
  scale_fill_manual(values=bc) + guides(color="none") + labs(fill = "population")

p3
```

```
## Warning: Removed 1 rows containing missing values (geom_segment).
```

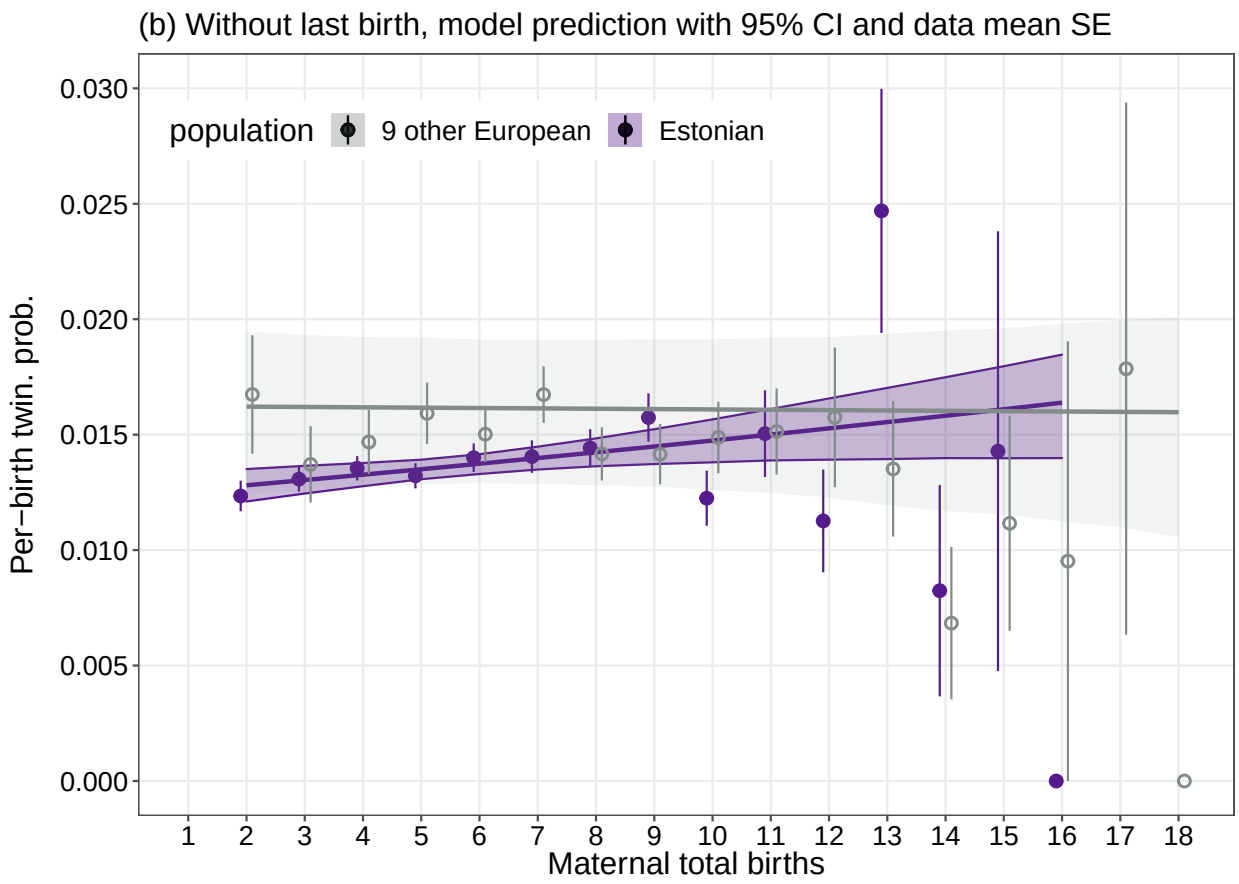


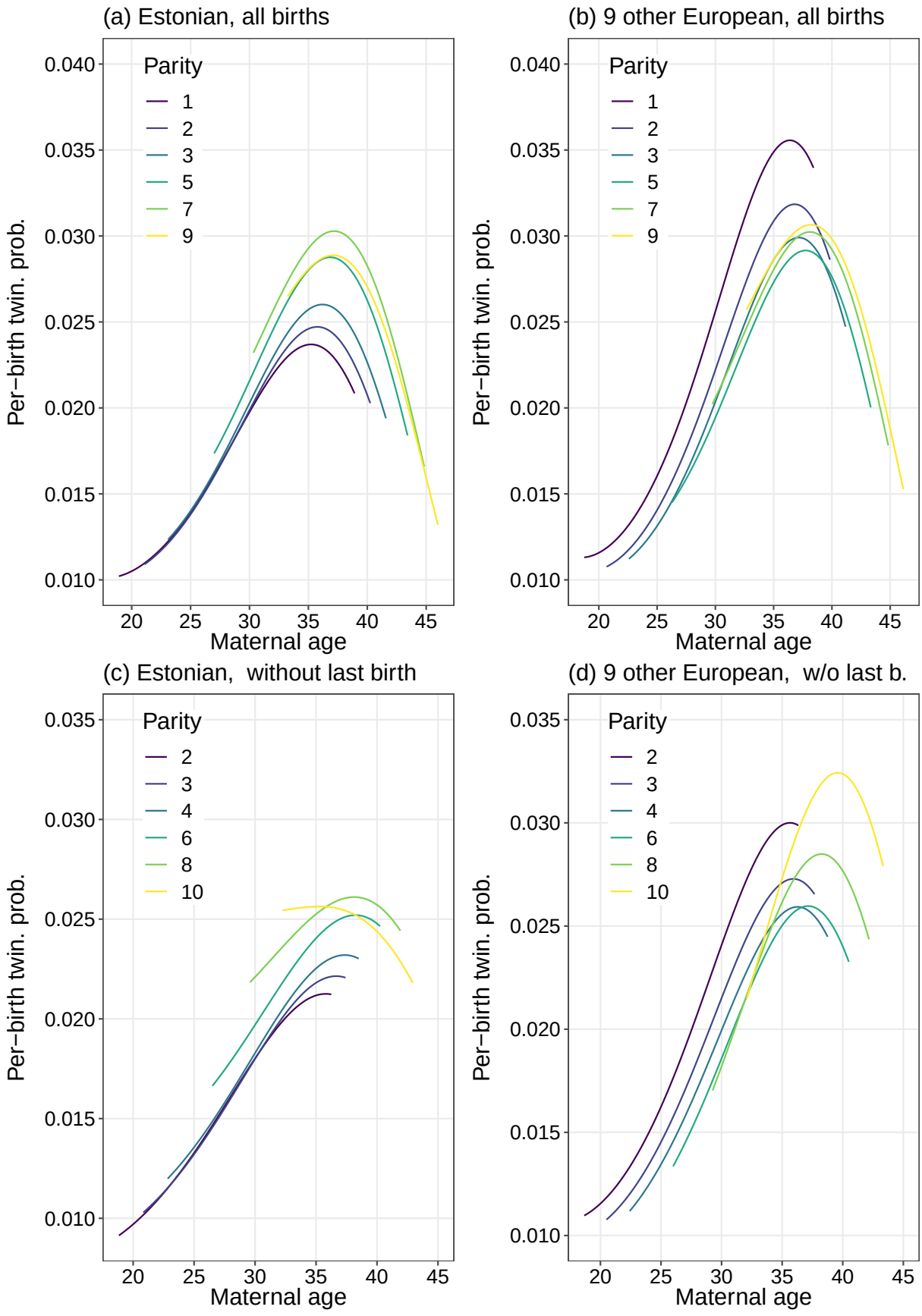
Figure 2: Model Mean Predictions from Birth Level Data

```
#use new draw_fig_4C function
source("./R/twinR_theme.R")
```

```
#extract predictions
fig4C_EE_plot_data <- dbm_EE_fit$results
fig4C_EE_plot_data$twin <- fig4C_EE_plot_data$estimates

fig4C_orig_plot_data <- dbm_orig_fit$results
fig4C_orig_plot_data$twin <- fig4C_orig_plot_data$estimates

fig4C_EE_nl_plot_data <- dbm_EE_nl_fit$results
fig4C_EE_nl_plot_data$twin <- fig4C_EE_nl_plot_data$estimates
fig4C_EE_nl_plot_data$parity <- fig4C_EE_nl_plot_data$parity + 1

fig4C_orig_nl_plot_data <- dbm_orig_nl_fit$results
fig4C_orig_nl_plot_data$twin <- fig4C_orig_nl_plot_data$estimates
fig4C_orig_nl_plot_data$parity <- fig4C_orig_nl_plot_data$parity + 1
```

```
rescale_cd <- scale_y_continuous(limits = c(NA, 0.035))

fig2b <- draw_fig_4C(fig4C_orig_plot_data) +
```

```
  labs(subtitle = paste0("(b) ",westLab,", all births"))

fig2a <- draw_fig_4C(fig4C_EE_plot_data) +
  labs(subtitle = paste0("(a) ",estLab,", all births"))

fig2d <- draw_fig_4C(fig4C_orig_nl_plot_data, y_lims = c(0.01, 0.035)) +
  labs(subtitle = paste0("(d) ",westLab,",  w/o last b."))

fig2c <- draw_fig_4C(fig4C_EE_nl_plot_data,y_lims = c(0.01, 0.035)) +
  labs(subtitle = paste0("(c) ",estLab,",  without last birth"))



gridExtra::grid.arrange(fig2a + guides(), fig2b, fig2c, fig2d, ncol=2)
```


(a) Estonian, all births
(b) 9 other European, all births
(c) Estonian, without last birth
(d) 9 other European, w/o last b.
Parity
1
2
3
5
7
9
4
6
8
10
Per−birth twin. prob.
Maternal age
0.010
0.015
0.020
0.025
0.030
0.035
0.040
20
25
30
35
40
45

```
#END
```