EHBEA 2012

Differential maternal mortality among matrilocal and patrilocal families during the first 3 years following last birth – *Evidence of an extended in-law conflict in historical Krummhörn?*

Edward Munch, 1897-9

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Overview

Differential maternal mortality among matrilocal and patrilocal families during the first 3 years following last birth

1. Introduction: Trade-offs in female reproduction and kin selection (life history theory and cooperative breeding)

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2. Material/Methods: Data sources, data selection, sample characteristics, and statistical models

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3. Results: Model estimates, model selection, and simulation studies (Kaplan-Meier-Plots)

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2. Material/Methods: Data sources, data selection, sample characteristics, and statistical models
3. Results: Model estimates, model selection, and simulation studies (Kaplan-Meier-Plots)
4. Discussion: The extended in-law conflict and sociocultural correlates explaining excess female mortality

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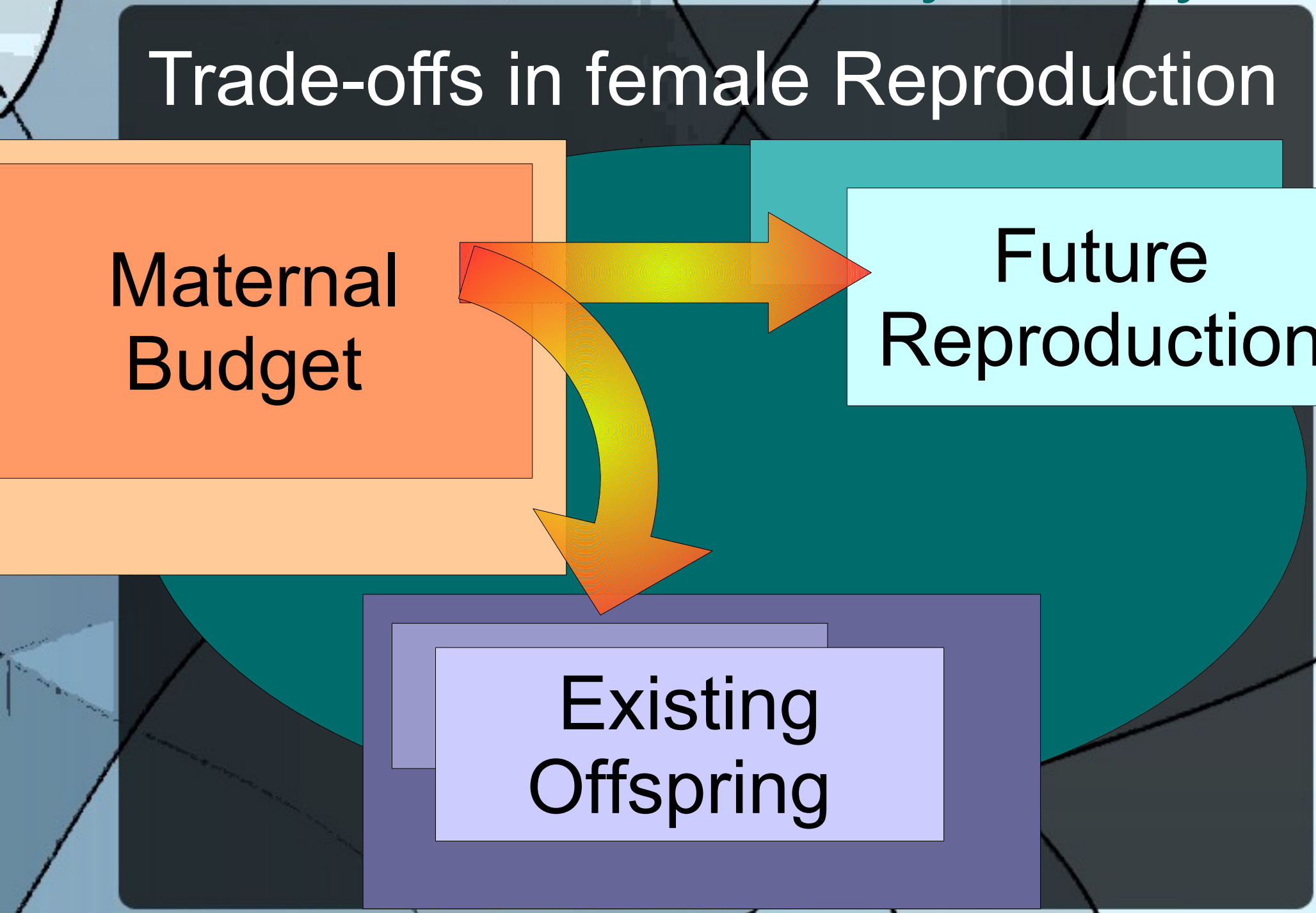
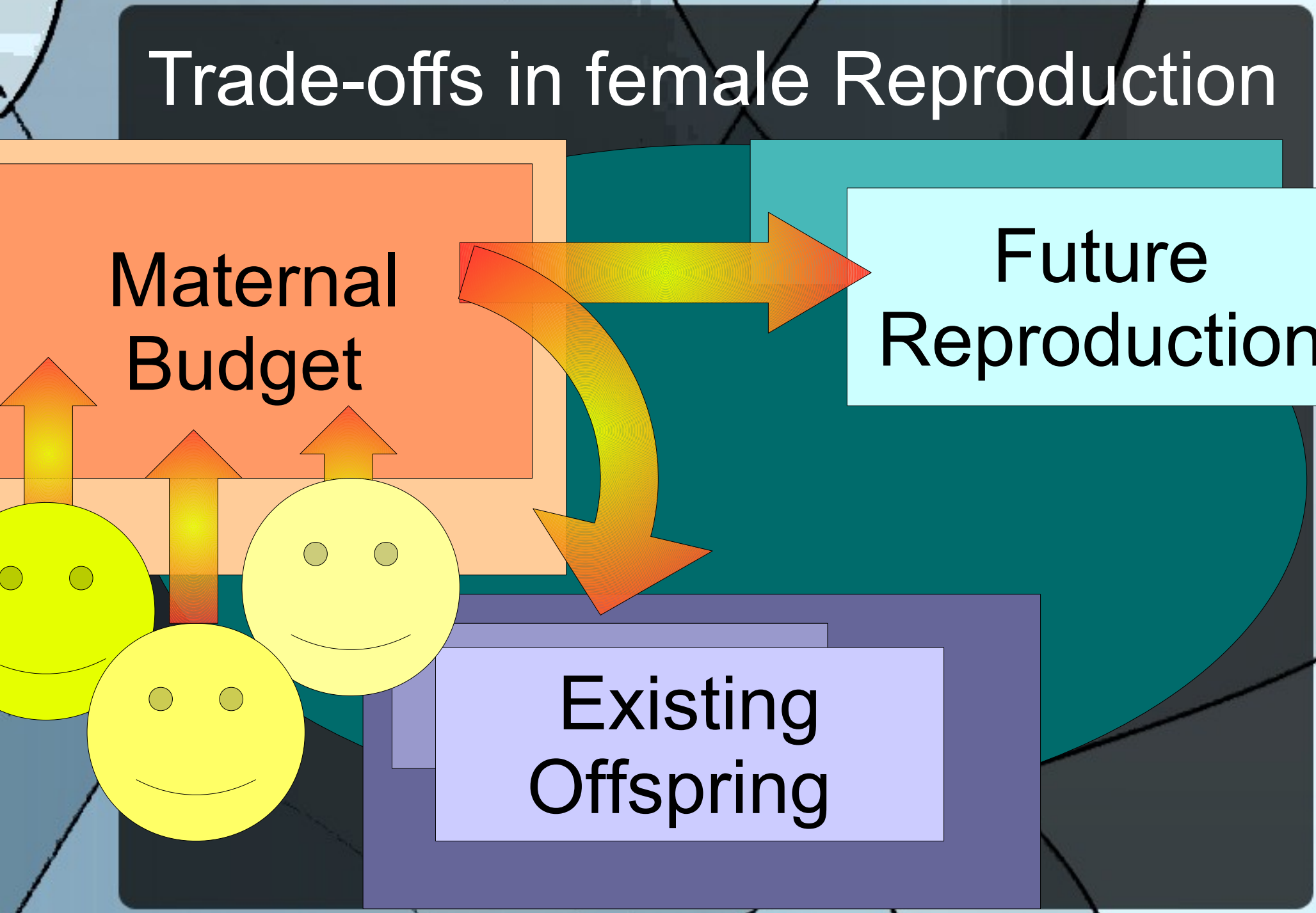
Introduction – Life History Theory



Introduction – Kin selection



Introduction – Hypothesis

Kin effects on trade-offs in female Reproduction may depend on...

1) Genetical relatedness

(e. g. genetic kin vs. in-laws)

2) Investment alternatives

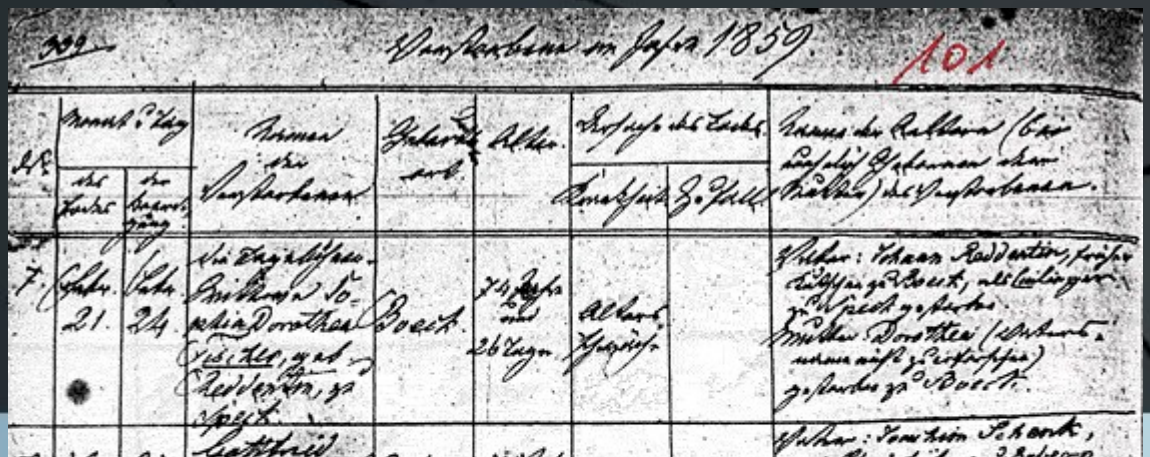
(i. e. potential competitors)

Methods

Data Sources

Genealogical linkage of vital events and socioeconomic data by methods of family reconstitution, based on historical data of the Krummhörn region 17th-18th centuries (see Voland 2000):

- Vital events through church register entries
- Socioeconomic data through tax records



Methods

Data Selection

- only parents who stem from complete natal families with completely-known birth-order

Methods

Data Selection

- only parents who stem from complete natal families with completely-known birth-order
- only mothers having their first birth after 1720 and their last birth before 1874

Methods

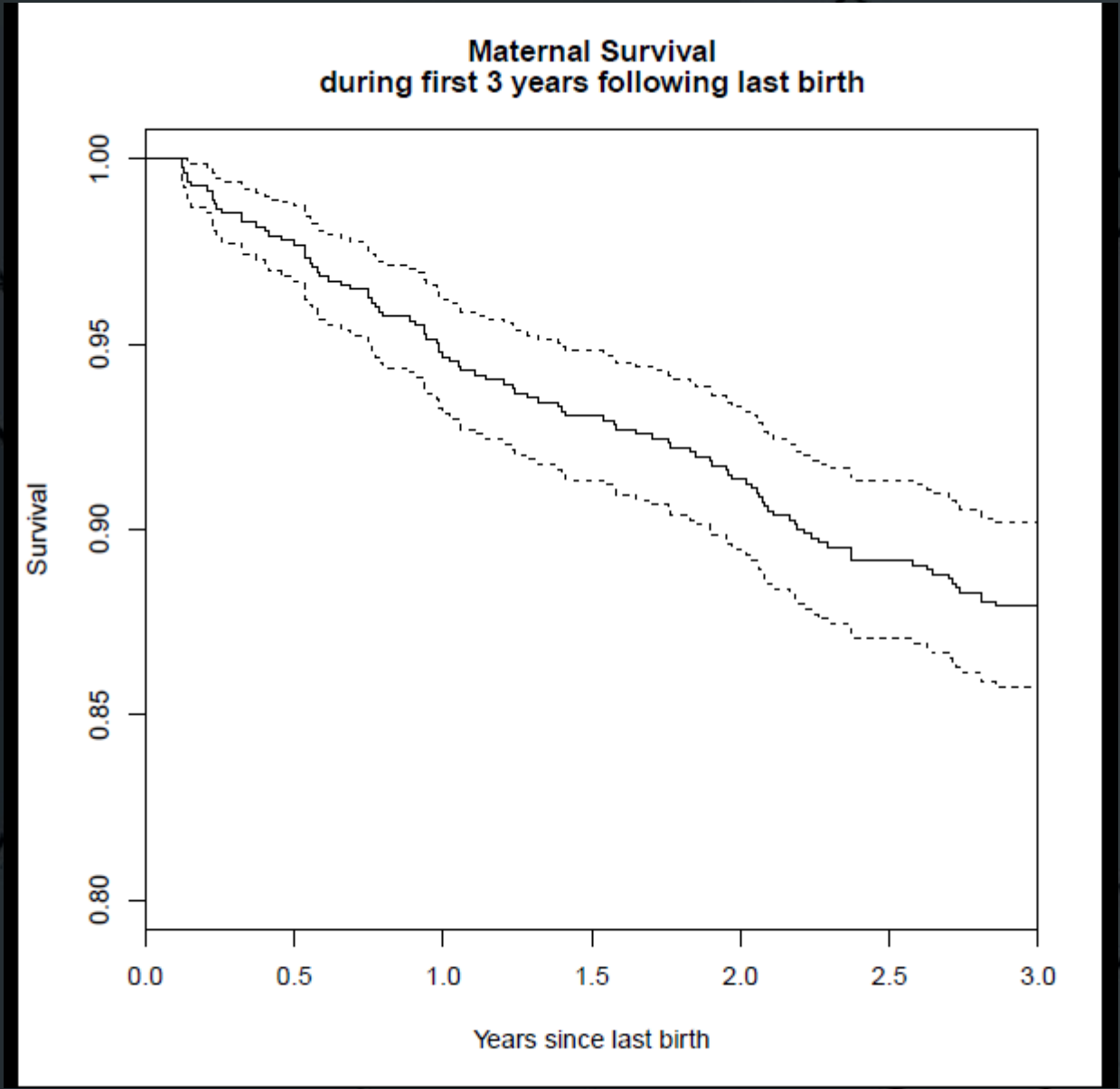
Data Selection

- only parents who stem from complete natal families with completely-known birth-order
- only mothers having their first birth after 1720 and their last birth before 1874
- Excluded cases: commercial farmers, "within-parish marriages" (i.e. both parents being philopatric), and mothers deceased during the first 42 days postpartum (assumed as "birth complications").

_____Final sample: N = 821, events = 99

Methods

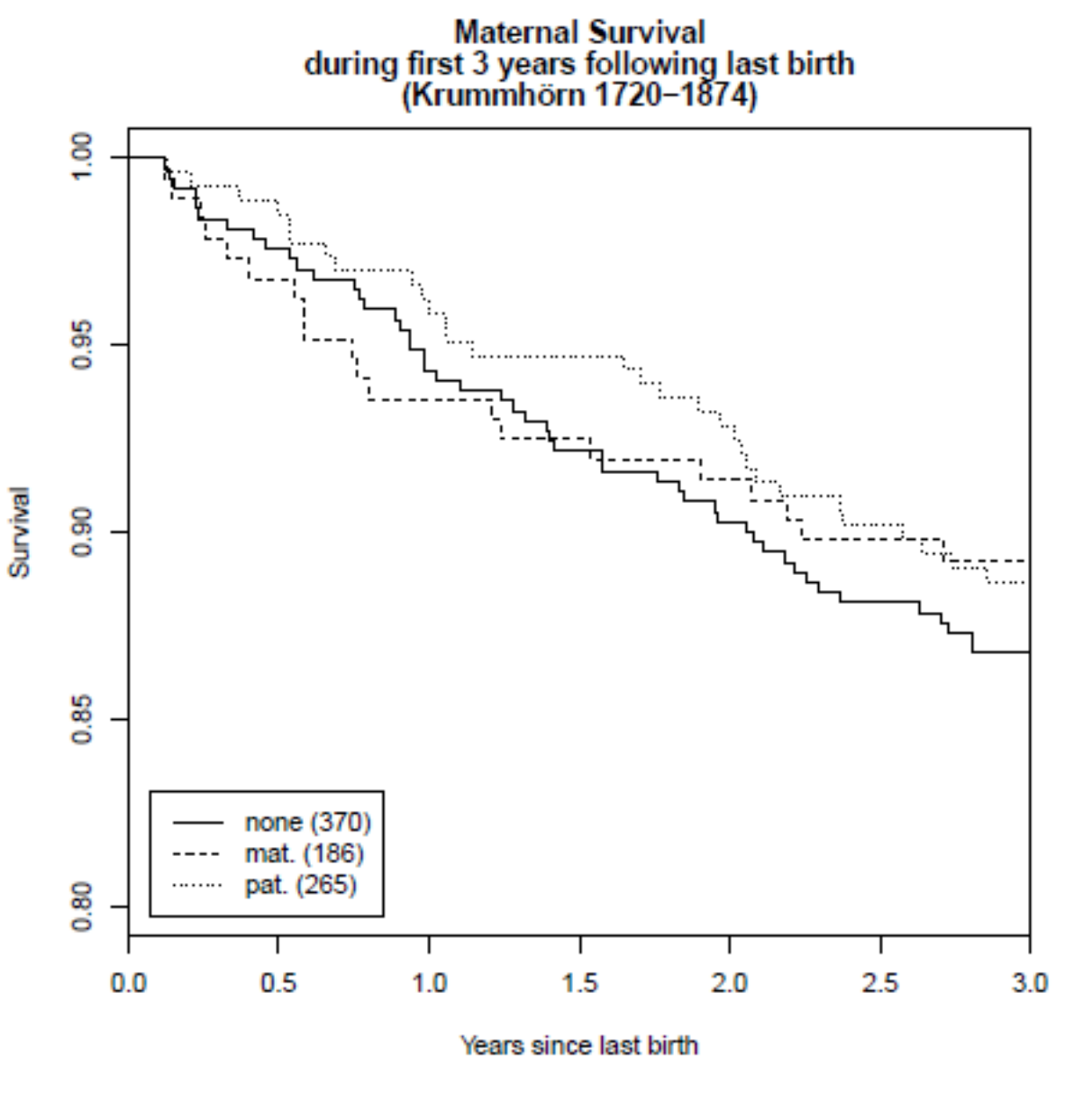
Final Sample (1720-1874)



Maternal survival during the first 3 years following last birth (N=821, events=99)

Methods

Final Sample (1720-1874)



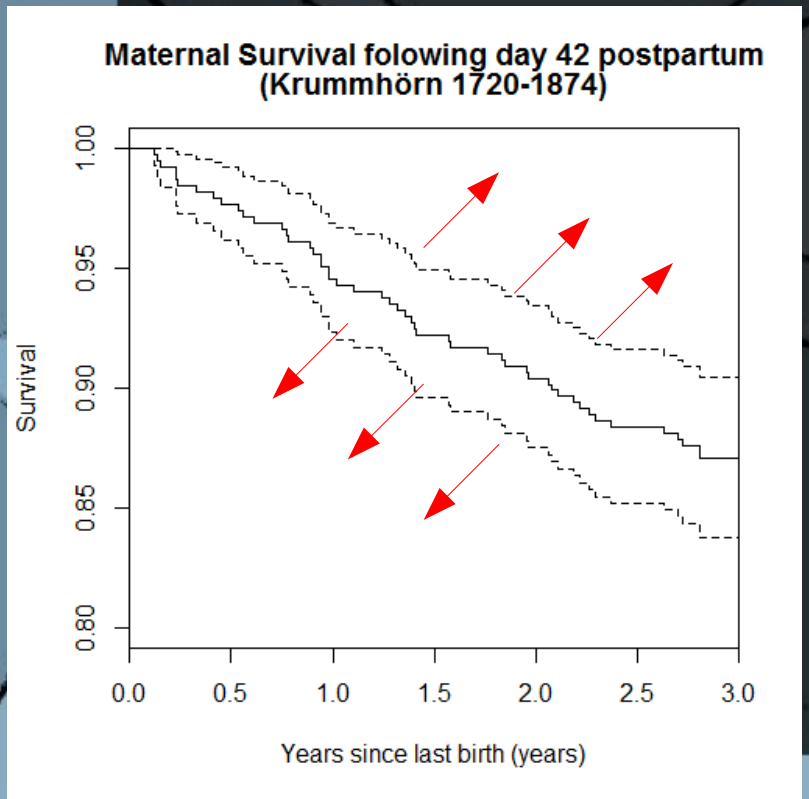
Maternal survival during the first 3 years following last birth

No significant differences between matrilocal and patrilocal families

Methods: The Cox PH model

LAST BIRTH → Hazard → Mother dies

Cox proportional hazards model with right censoring



The risk indicator $Y_i(t)$ models the baseline hazard $\lambda(t)$ which is multiplied with a vector of linear predictors $X_i(t)$ and their coefficients.

Results – Model estimates

Model I: Maternal mortality during first 3 years following last birth (n = 821, events = 99):

	Hazard Ratio[1]	lower 95% CI	upper 95% CI
Season of last birth (winter)	0.64 .	0.39	1.05
Parity[2]	1.51 ***	1.26	1.80
Age at first birth[2]	1.23 ***	1.12	1.36
Age at last birth[2]	0.74 ***	0.68	0.81
Parity:Age at last birth	0.99 .	0.97	1.00

Concordance= 0.728 (se = 0.129) R^2= 0.072 (max possible= 0.583)

Wald test = 56.77 on 5 df, p=5.63e-11, Robust = 50.09 p=1.33e-09

[1] Significance codes: *** = p<0.001; . = p<0.1

[2] Covariates centered around their median.

Hazard ratio: „Probability of event occuring in the time period compared to reference group“

Results – Model estimates

Model II: Maternal mortality during first 3 years following last birth, added predictors: place of residence (n = 821, events = 99):

	Hazard ratio	lower 95% CI	upper 95 % CI
Season of last birth (winter)	1.07	0.58	2.00
Parity[2]	1.37 **	1.13	1.66
Age at first birth[2]	1.14 *	1.02	1.27
Age at last birth[2]	0.81 ***	0.74	0.88
matrilocal	0.66	0.26	1.69
patrilocal	0.58	0.26	1.34
matrilocal:winter	0.23 *	0.05	0.99
matrilocal:Age at last birth	0.89 *	0.80	0.99
patrilocal:winter	0.34	0.09	1.29
patrilocal:Parity	1.47 .	0.97	2.24
patrilocal:Age at first birth	1.41 **	1.12	1.76
patrilocal:Age at last birth	0.80 *	0.66	0.97
Parity:Age at last birth	0.98 .	0.97	1.00

Concordance= 0.763 (se = 0.129) R^2= 0.094 (max possible= 0.583)

Wald test = 86.14 on 13 df, p=7.612e-13, Robust = 61.22 p=3.169e-08

[1] Significance codes: *** = p<0.001; ** = p<0.01; * = p<0.05; . = p<0.1

[2] Covariates centered around their median.

Results – Model estimates

Model III: Maternal mortality during first 3 years following last birth, added predictors: lineage and sex of kin (n = 821, events = 99):

	Hazard Ratio[1]	lower 95% CI	upper 95% CI
maternal grandfather (MGF)	0.73	0.41	1.30
matrilocal	0.12 .	0.01	1.00
brothers-in-law	1.05	0.86	1.30
sisters-in-law	0.97	0.78	1.20
patrilocal	0.52	0.16	1.65
Season of last birth (winter)	1.10	0.60	2.05
Parity[2]	1.42 ***	1.16	1.73
Age at first birth[2]	1.16 *	1.03	1.30
Age at last birth[2]	0.80 ***	0.73	0.87
MGF:matrilocal	12.10 *	1.54	94.79
brothers-in-law:patrilcocal	0.68 *	0.47	0.99
sisters-in-law:patrilocal	1.44 .	1.00	2.09
matrilocal:winter	0.21	0.05	0.91
matrilocal:Age at last birth	0.91 *	0.82	1.02
patrilocal:winter	0.23 *	0.06	0.87
patrilocal:Parity	1.59 *	1.06	2.39
patrilocal:Age at first birth	1.44 **	1.15	1.82
patrilocal:Age at last birth	0.75 **	0.61	0.93
Parity:Age at last birth	0.99 .	0.97	1.00

Concordance= 0.778 (se = 0.129) R^2= 0.114 (max possible= 0.583)

Wald test = 104 on 19 df, p=1.011e-13, Robust = 69.08 p=1.308e-07

[1] Significance codes: *** = p<0.001; ** = p<0.01; * = p < 0.05; . = p<0.1

[2] Covariates centered around their median.

Results – Model estimates

Model IV: Maternal mortality during first 3 years following last birth, added predictors: birth order of kin

	Hazard Ratio[1]	lower 95% CI	upper 95% CI
maternal grandfather (MGF)	0.73	0.40	1.33
younger brothers (yBRO)	0.84	0.63	1.11
matrilocal	0.08 *	0.01	0.71
older brothers-in-law (oBIL)	1.15	0.92	1.44
older sisters-in-law (oSIL)	1.01	0.76	1.35
patrilocal	0.51	0.20	1.33
Season of last birth (winter)	1.08	0.58	2.00
Parity[2]	1.42 ***	1.17	1.72
Age at first birth[2]	1.16 **	1.04	1.29
Age at last birth[2]	0.80 ***	0.73	0.87
MGF:matrilocal	11.74 *	1.45	94.94
yBRO:matrilocal	1.52 *	1.00	2.30
oBIL:patrilocal	0.56 *	0.34	0.93
oSIL:patrilocal	1.80 *	1.07	3.03
matrilocal:winter	0.23 *	0.06	0.94
matrilocal:Age at last birth	0.91 .	0.81	1.02
patrilocal:winter	0.27 .	0.07	1.09
patrilocal:Parity	1.55 *	1.05	2.29
patrilocal:Age at first birth	1.44 **	1.16	1.78
patrilocal:Age at last birth	0.76 **	0.63	0.92
Parity:Age at last birth	0.98 .	0.97	1.00

Concordance= 0.771 (se = 0.129) R^2= 0.118 (max possible= 0.583)

Wald test = 108.9 on 21 df, p=7.405e-14, Robust = 70.39 p=3.04e-07

[1] Significance codes: *** = p<0.001; ** = p<0.01; * = p < 0.05; = p<0.1

Results

Model selection

	R^2	loglik	χ^2	Df	P	AIC
Model I	0.072	-328.52				667.04
Model II	0.094	-318.50	20.03	8	0.01 *	663.01
Model III	0.114	-309.45	18.11	6	0.006 **	656.90
Model IV	0.118	-307.54	3.82	2	0.15	657.08

Goodness-of-fit increases significantly from Model I to III.

No significant difference (P = 0.15) between Model III and IV.

Model III and IV have VERY similar AIC (Δ 0.18)

Model IV has largest log likelihood and R^2

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Model IV has largest log likelihood and R^2

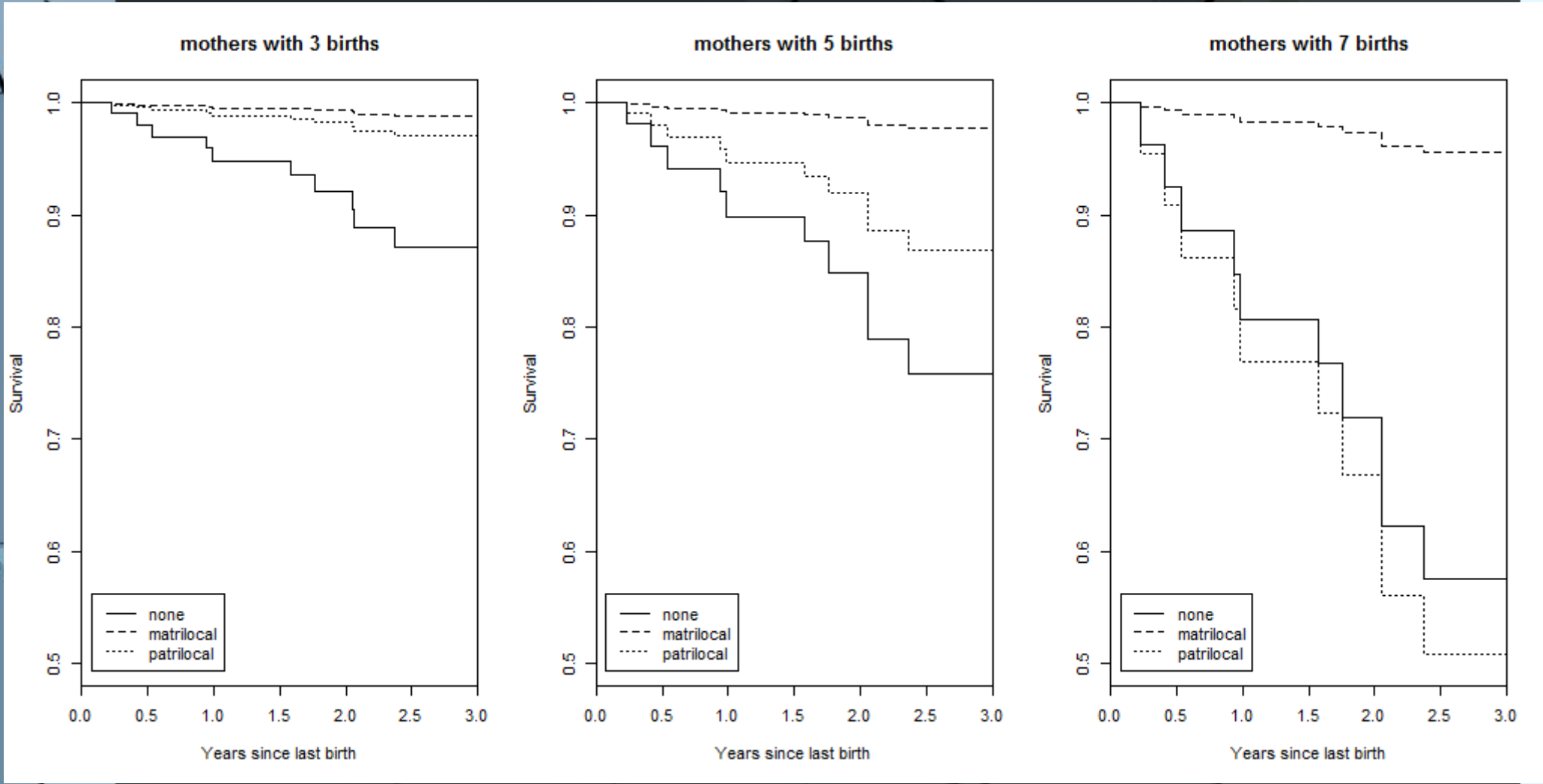
Results

Model IV Estimates

- Increased effects of maternal age and parity on the hazard (during the first 3 years following last birth) among patrilocal (but not matrilocal) families (as in Models II&III).

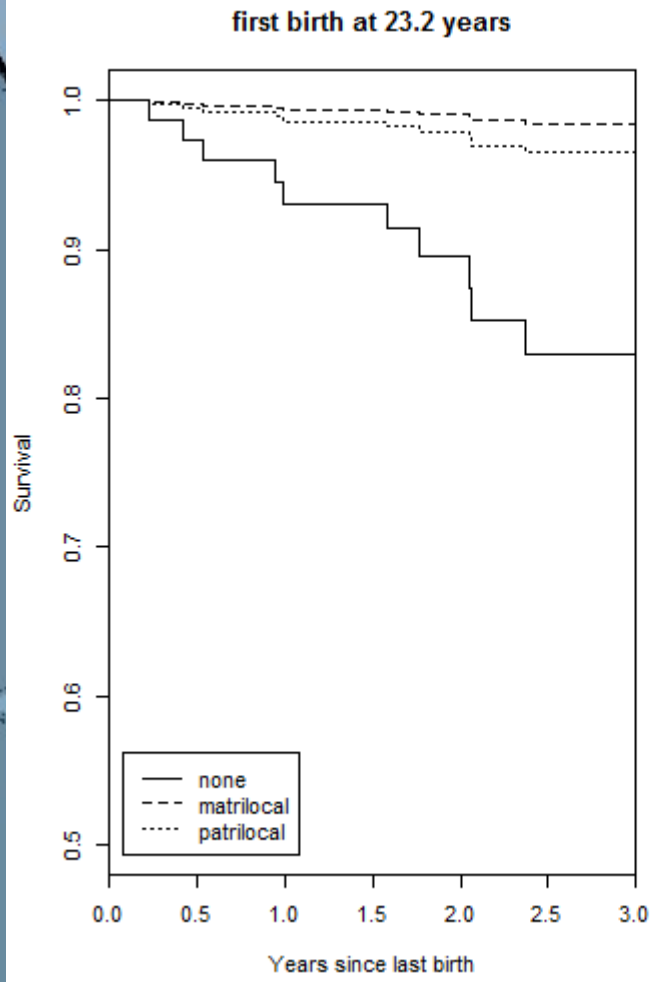
Results – Model predictions

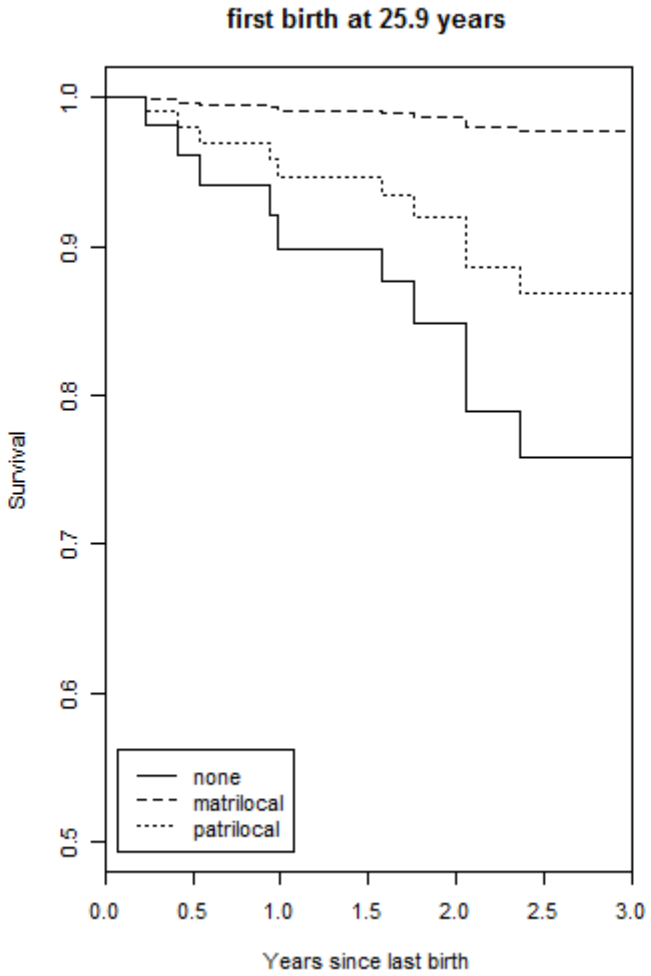
Impact of total parity

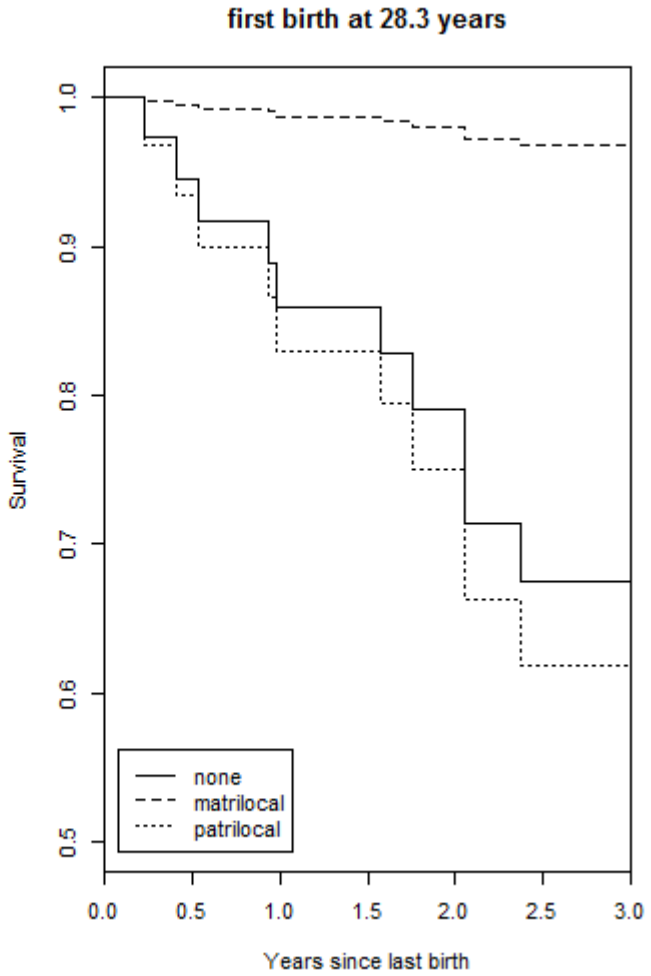


Results – Model predictions

Impact of age at first birth

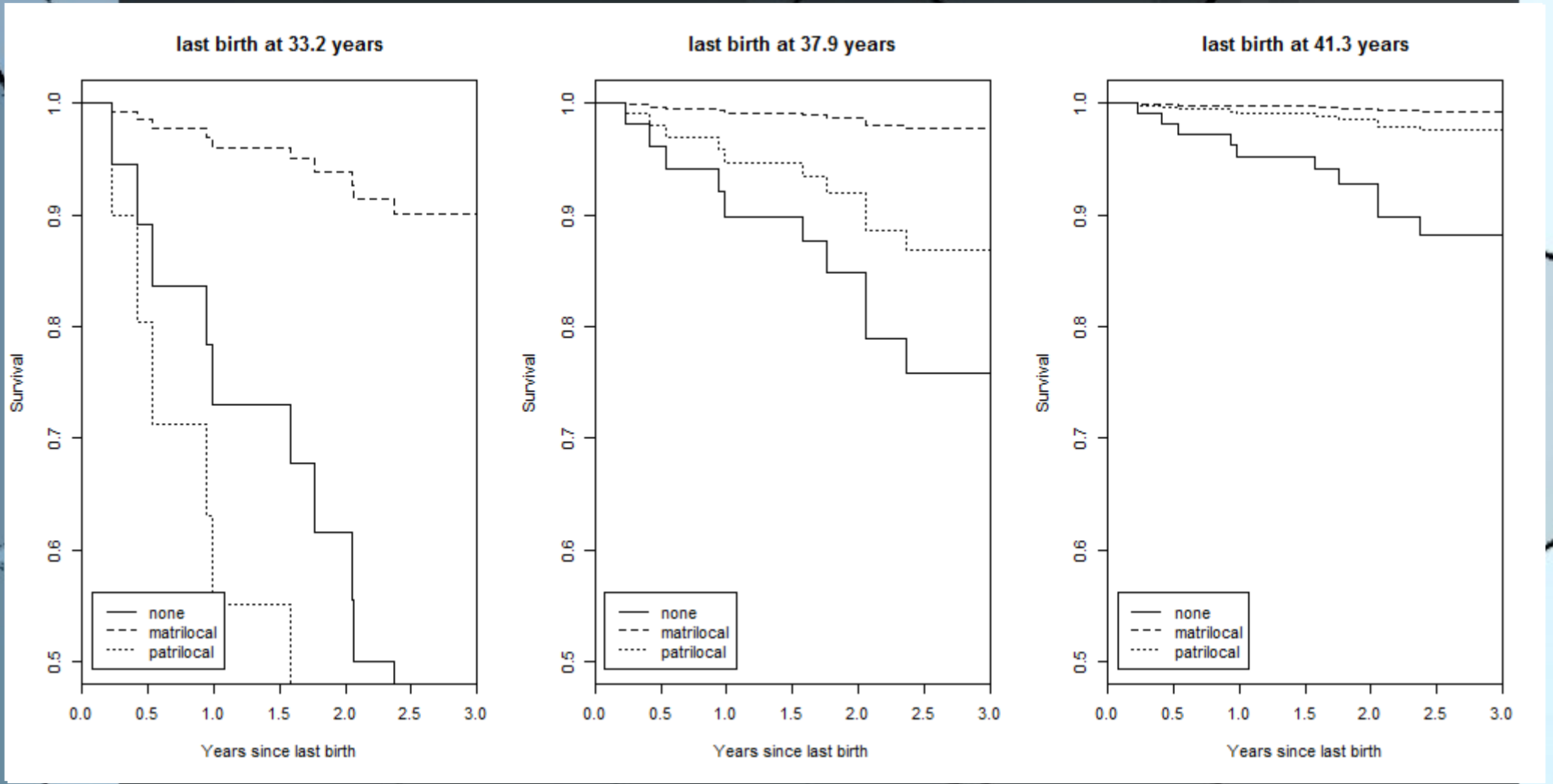






Results – Model predictions

Impact of age at last birth



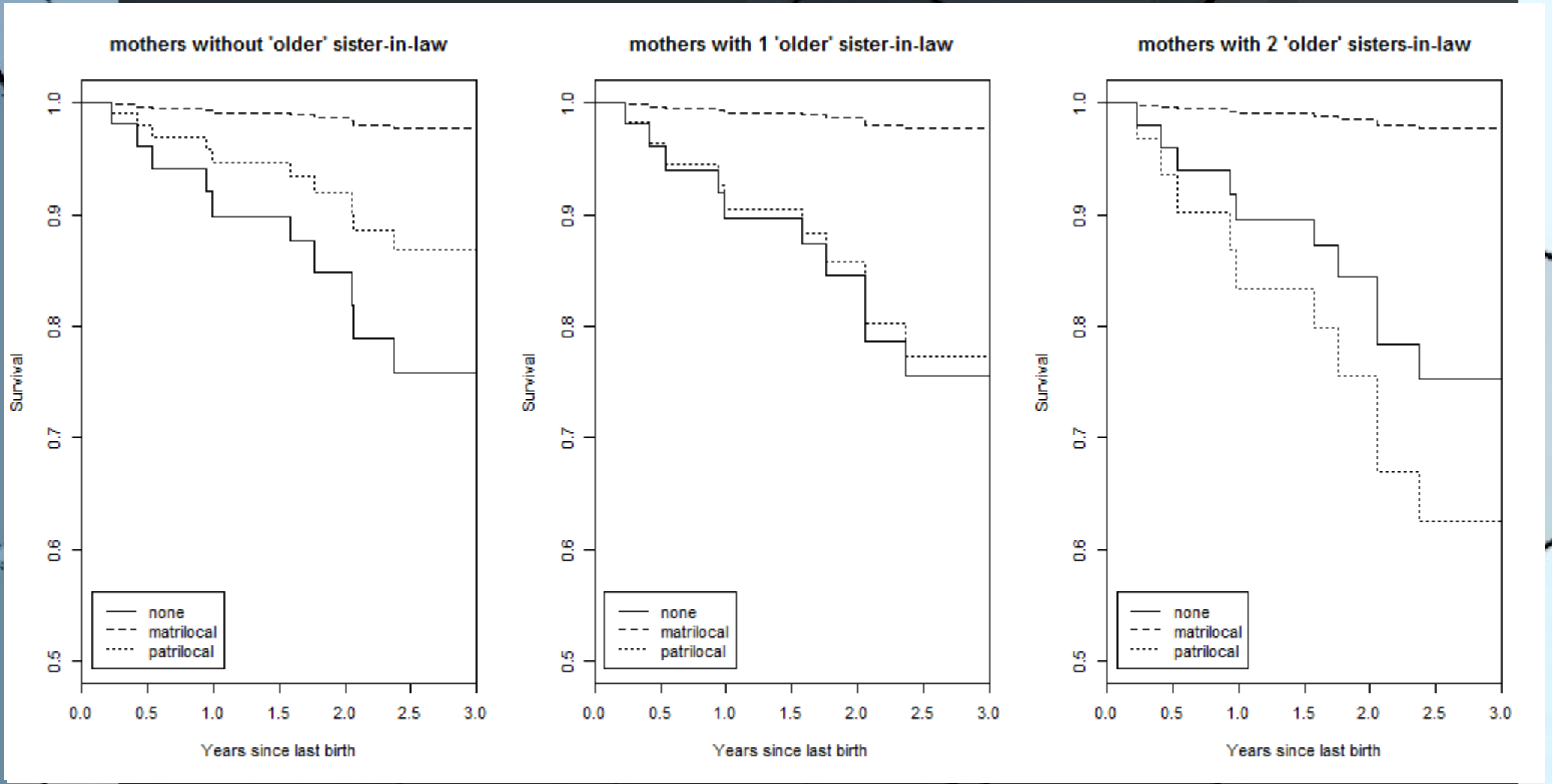
Results

Model IV Estimates

- Increased effects of maternal age and parity on the hazard (during the first 3 years following last birth) among patrilocal (but not matrilocal) families (cf. models II & III).
- Harmful effect of older sisters-in-law, but not older brothers-in-law. Only minor effects of the maternal grandfather and younger brothers of the mother (cf. model III).

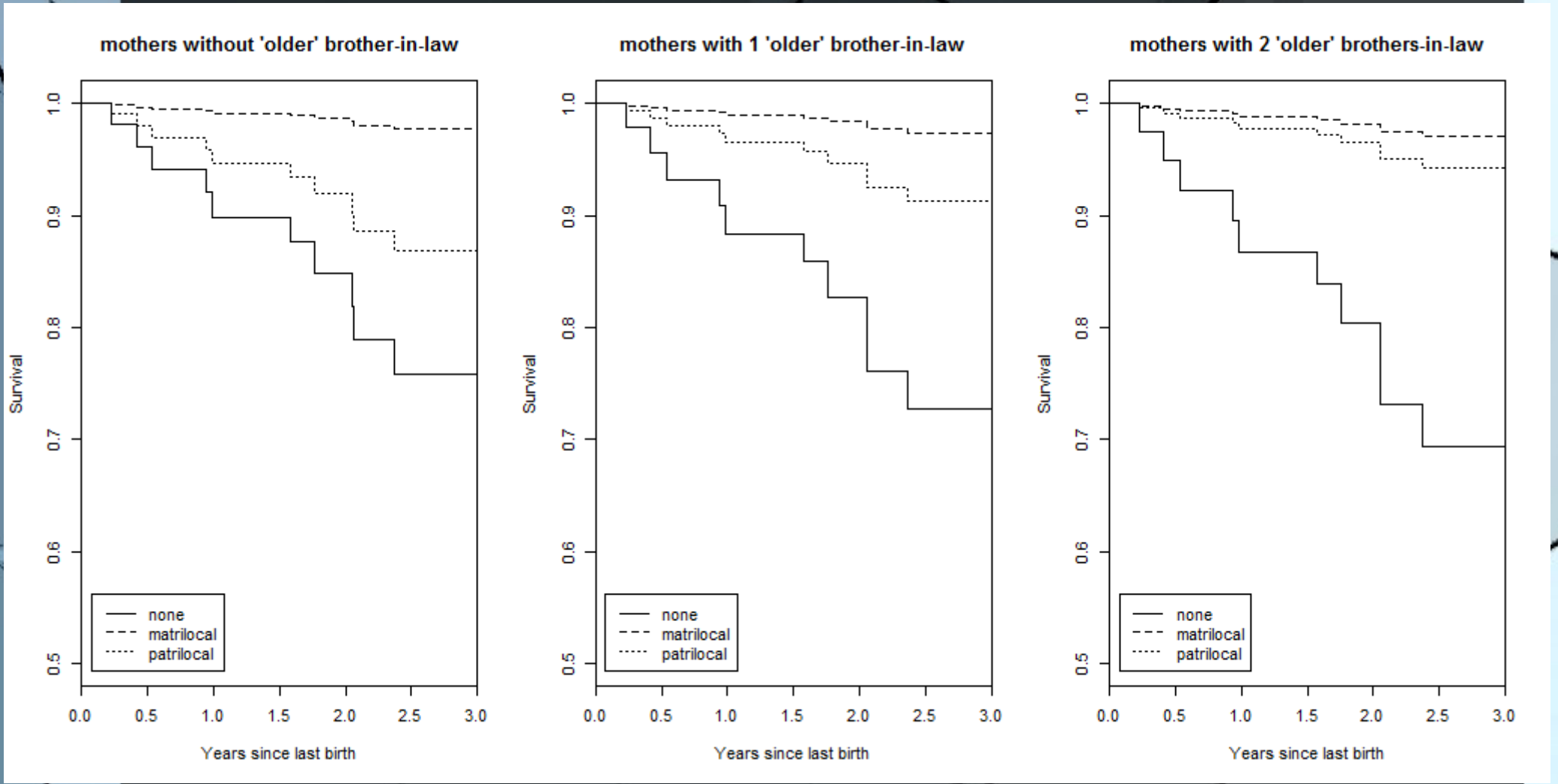
Results – Model simulations

Impact of “older“ sister(s)-in-law



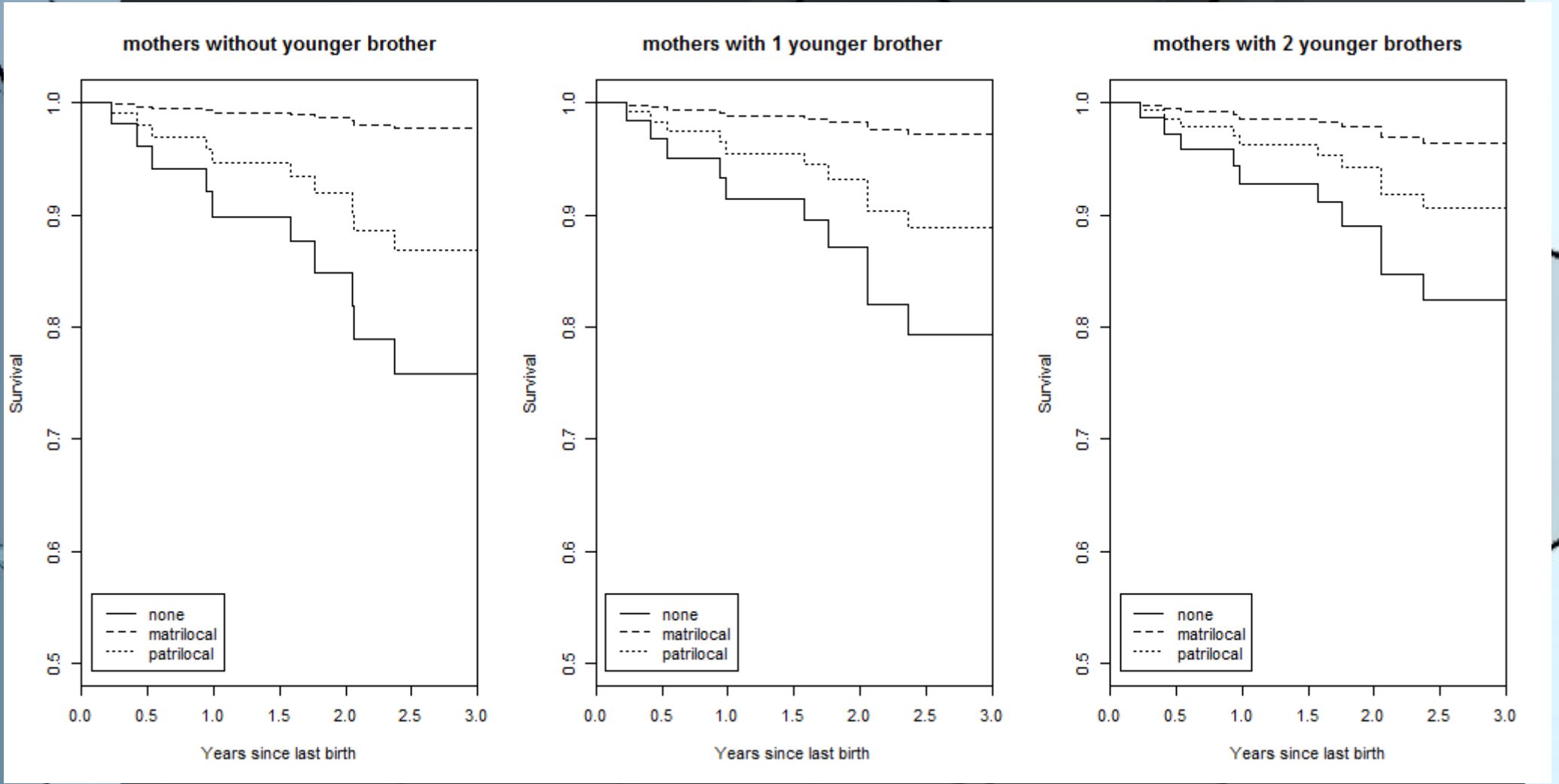
Results – Model predictions

Impact of “older“ brother(s)-in-law



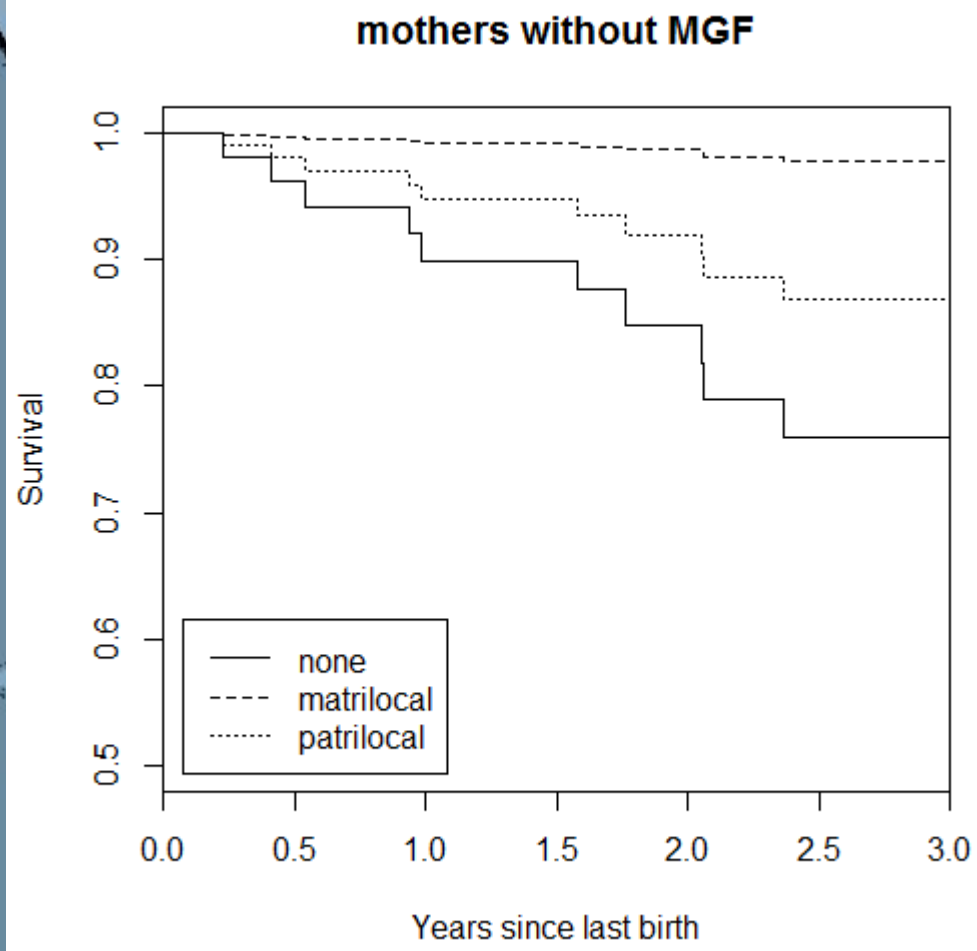
Results – Model predictions

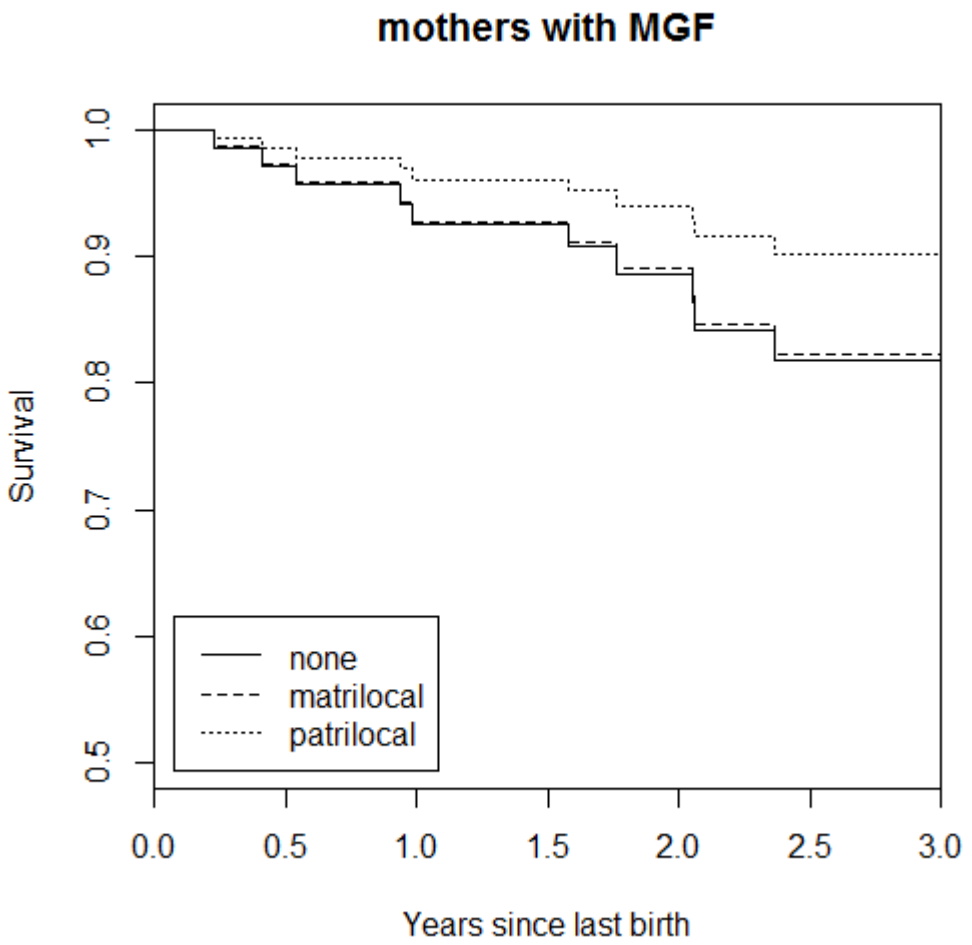
Impact of younger brother(s)



Results – Model predictions

Impact of maternal grandfather





Conclusions

Kin selection and in-law conflict

The final model chosen by conventional selection criteria (log lik. & AIC) includes predictors both for sex and lineage of parental kin as well as the residential place.

Effects do depend on the interaction of these terms: Kin of the parents only effect maternal hazard if living nearby the mother.

Conclusions

Sociocultural dimensions of the in-law conflict:
– German Idioms –

"Kuhverrecke grosser Schrecke,
Weibersterbe kein Verderben"

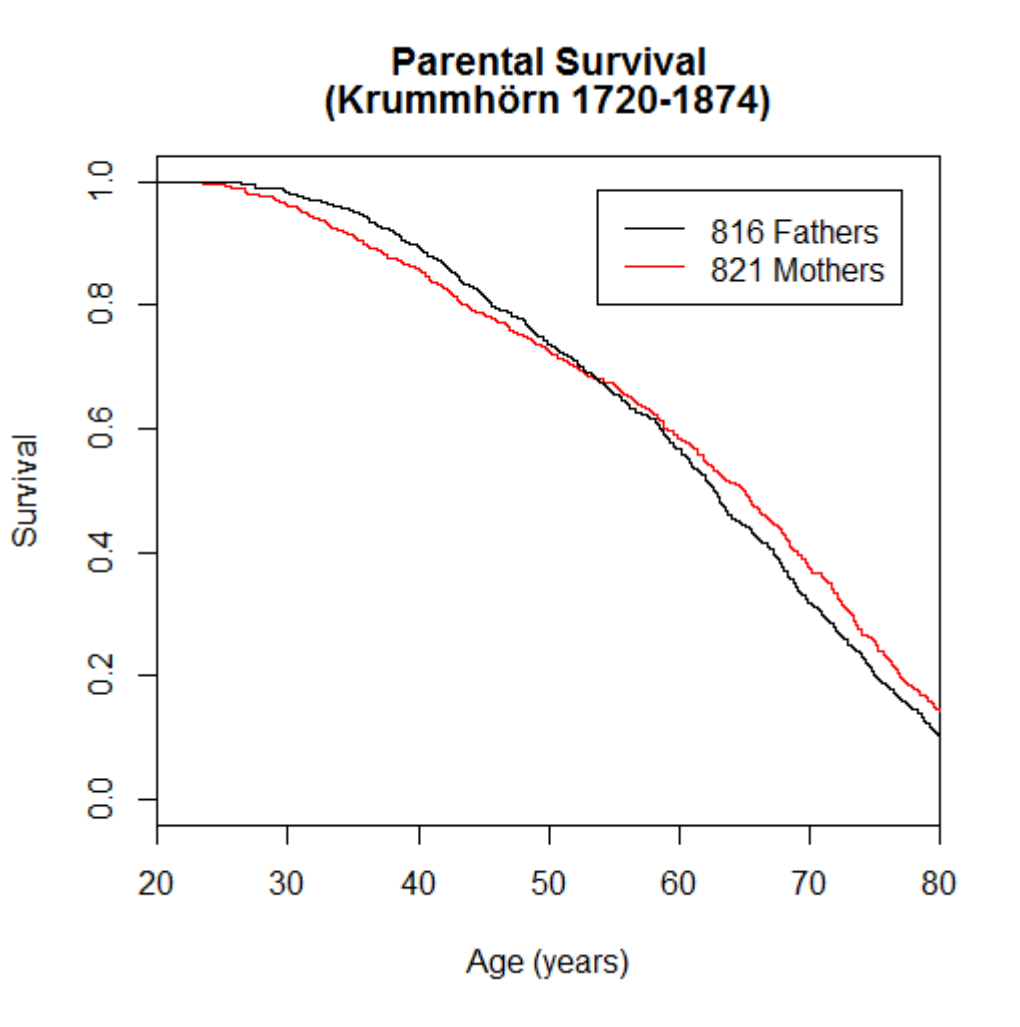
[If the cow kicks off, mighty cross -
If the wife kicks off, no big loss.]

"Weiber Sterben, Kein Verderben, Gaul
verrecken, das macht Schrecken."

[Got a dead wife? No big deal -
Got a dead horse? How you squeal.]

Cited in Klasen, J. Econ. Hist.,1998

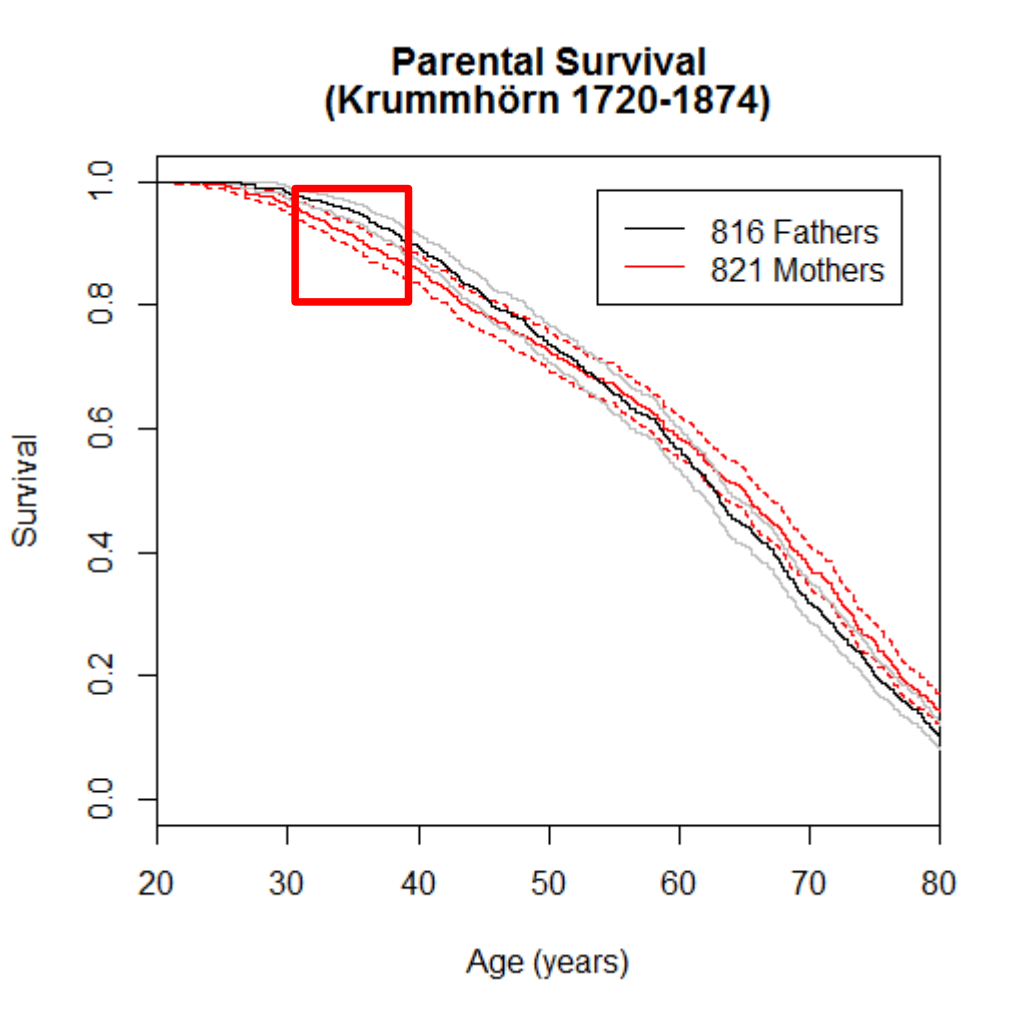
Conclusions



Excess Female Mortality among parents in historical Krummhörn

(see also Klasen, J Econ Hist, 1998)

Conclusions



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This work was supported by the “Darwin scholarship programme“ funded by the Justus-Liebig-Universität Gießen, Germany.

I am also thankful to Eckart Voland for helpful advice and inspiring discussion.

And I would like to thank you for your kind attention, and (hopefully!) some questions and discussion, too.

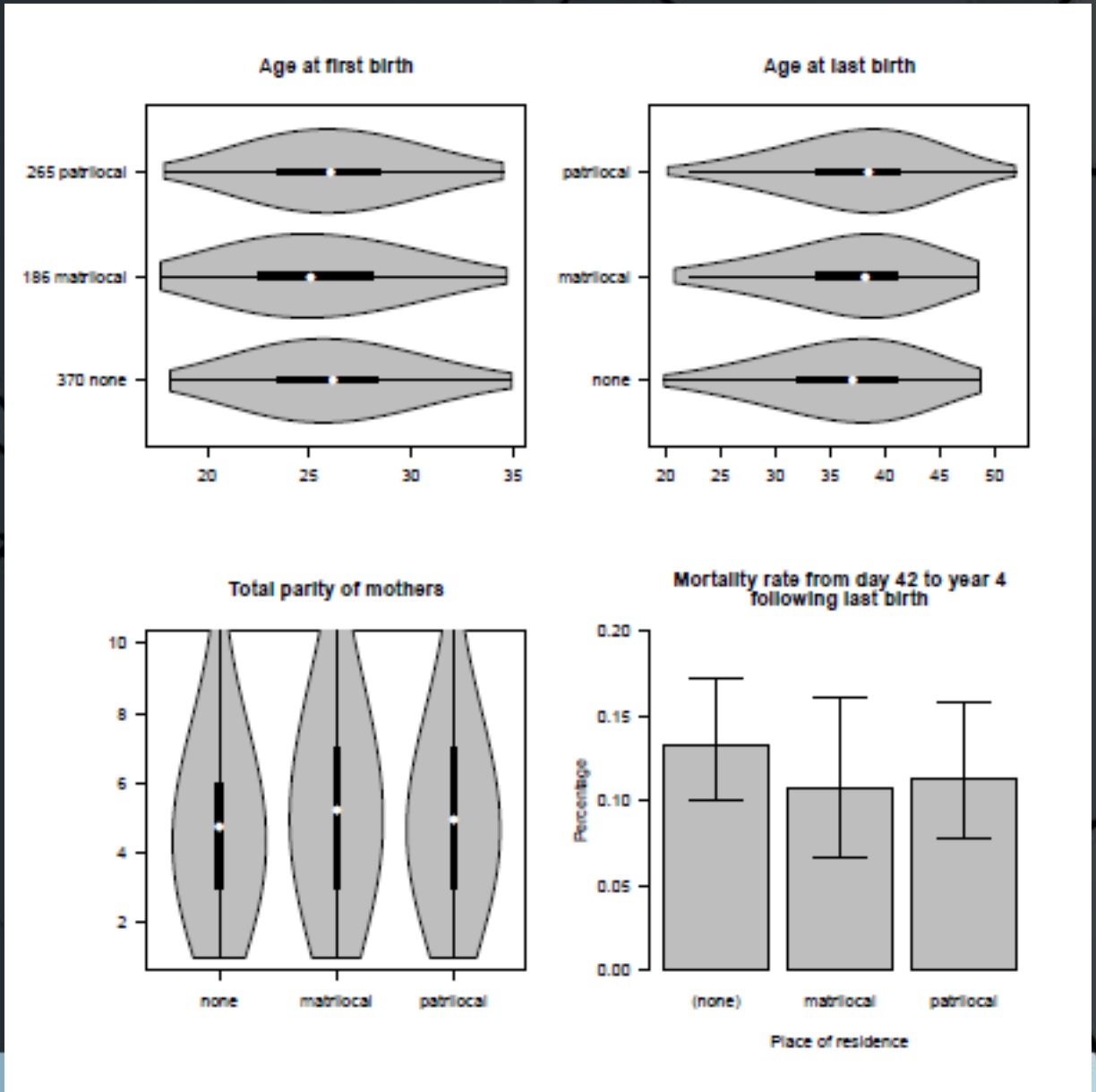
Thanks!

Methods

Fertility differences

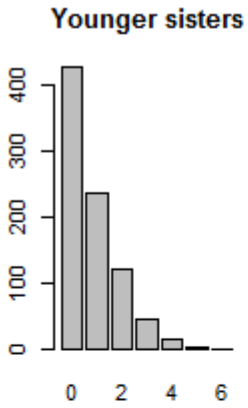
Methods

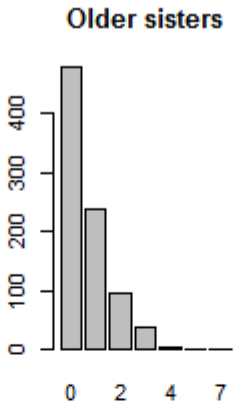
Maternal age at birth and mortality rate

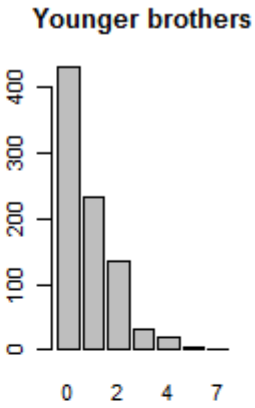


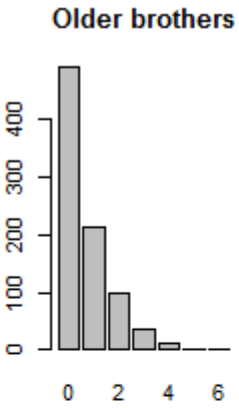
Methods

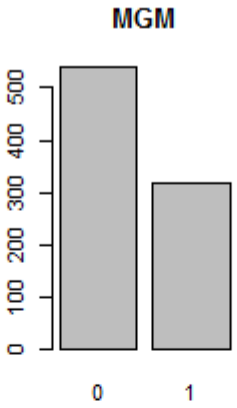
Kin included in study

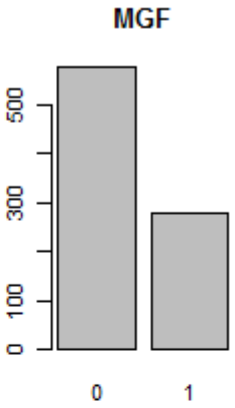


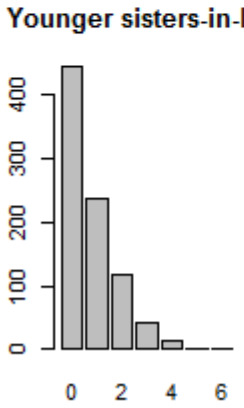


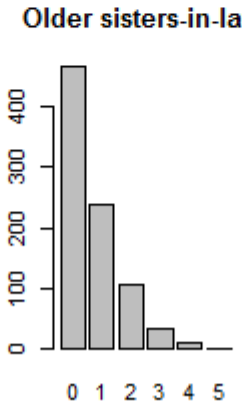


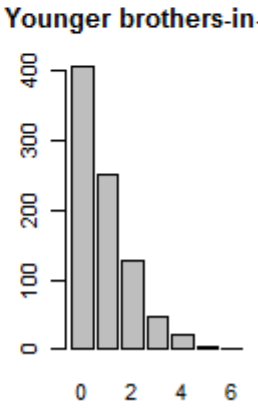


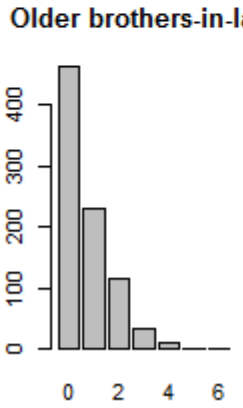


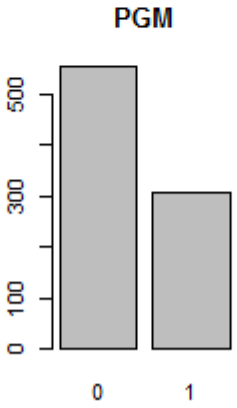


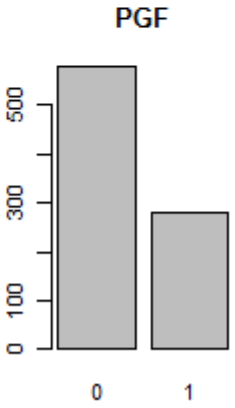






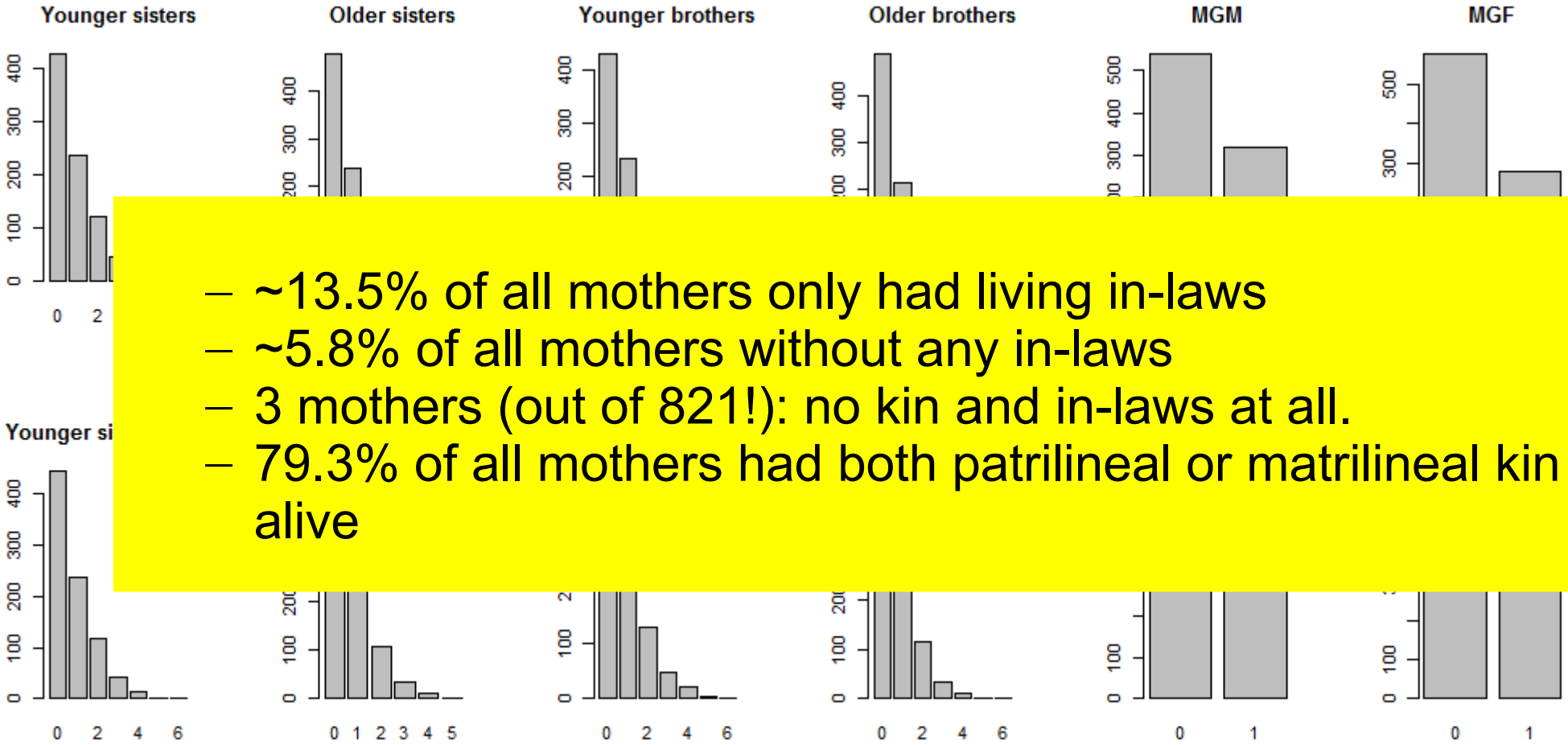






Methods

Kinship in historical Krummhörn is common but diverse



- ~13.5% of all mothers only had living in-laws
- ~5.8% of all mothers without any in-laws
- 3 mothers (out of 821!): no kin and in-laws at all.
- 79.3% of all mothers had both patrilineal or matrilineal kin alive

Methods: Model building

Step 1

- Include variables considered important from a theoretical standpoint (i.e. previous research) with first-order interactions

Methods: Model selection

Step 1

- Include variables considered important from a theoretical standpoint (i.e. previous research) with first-order interactions

Step 2

- Perform backward model selection by AIC to choose the best fit model

Methods: Model extension

Step 1
- Include variables considered important from a theoretical standpoint (i.e. previous research) with first-order interactions

Step 2
- Perform backward model selection by AIC to choose the best fit model

Step 3
- Add new predictors, repeat Step 2

Methods: Model selection

Step 1
- Include variables considered important from a theoretical standpoint (i.e. previous research) with first-order interactions

Step 2
- Perform backward model selection by AIC to choose the best fit model

Step 3
- Add new predictors, repeat Step 2

Step 4
- Compare all candidate models (R^2, Analysis of Deviance, and AIC)