

Supplemental Methods

We compute effects of indirect assortative mating on genetic parameters in Figure 1 following equations derived by Gianola (GIANOLA 1982). Specifically let A and F be two phenotypes in a population. Furthermore assume that under random mating in said population the heritabilities of A and F are h_A^2 and h_F^2 respectively and their genetic correlation is ρ_g . Assortative mating on phenotype A leads to changes in the heritabilities of A and F as well as their genetic correlations, and under continued assortative mating these quantities will reach an equilibrium. Specifically under continued assortment on A with partner correlation ρ_{couple} the equilibrium heritability of the assortment trait A is given by

$$\hat{h}_A^2 = \frac{\hat{\sigma}_{g_A}^2}{\hat{\sigma}_{g_A}^2 + \sigma_{e_A}^2} \text{ where } \hat{\sigma}_{g_A}^2 = \frac{2h_A^2 - 1 + \sqrt{1 - 4\rho_{couple}h_A^2(1 - h_A^2)}}{2(1 - \rho_{couple})}$$

the equilibrium genetic correlation is given by

$$\hat{\rho}_g = \rho_g \left(1 - \rho_{couple} \hat{h}_A^2 (1 - \rho_g^2)\right)^{-\frac{1}{2}}$$

and the equilibrium heritability of the focal trait F given by

$$\hat{h}_F^2 = \frac{\hat{\sigma}_{g_F}^2}{\hat{\sigma}_{g_F}^2 + \sigma_{e_F}^2} \text{ where } \hat{\sigma}_{g_F}^2 = \frac{2h_F^2 - 1 + \sqrt{1 - 4\rho_{couple}\hat{\rho}_g^2 h_A^2 (1 - h_A^2)}}{2(1 - \rho_{couple}\hat{\rho}_g^2)}.$$

We provide an online calculator to compute the effects of direct and indirect assortative mating on genetic parameters (<https://konradrawlik.github.io/IndirectAssortativeMating/>).

Figure S1: Density of correlations between parent's life spans for 10,000 fictitious couples with assortment structure due to Birth Location and Birth Year matching that of observed couples in either the UK Biobank or Familinx cohort. The black vertical line indicates the correlations observed in real couples in the respective cohort.

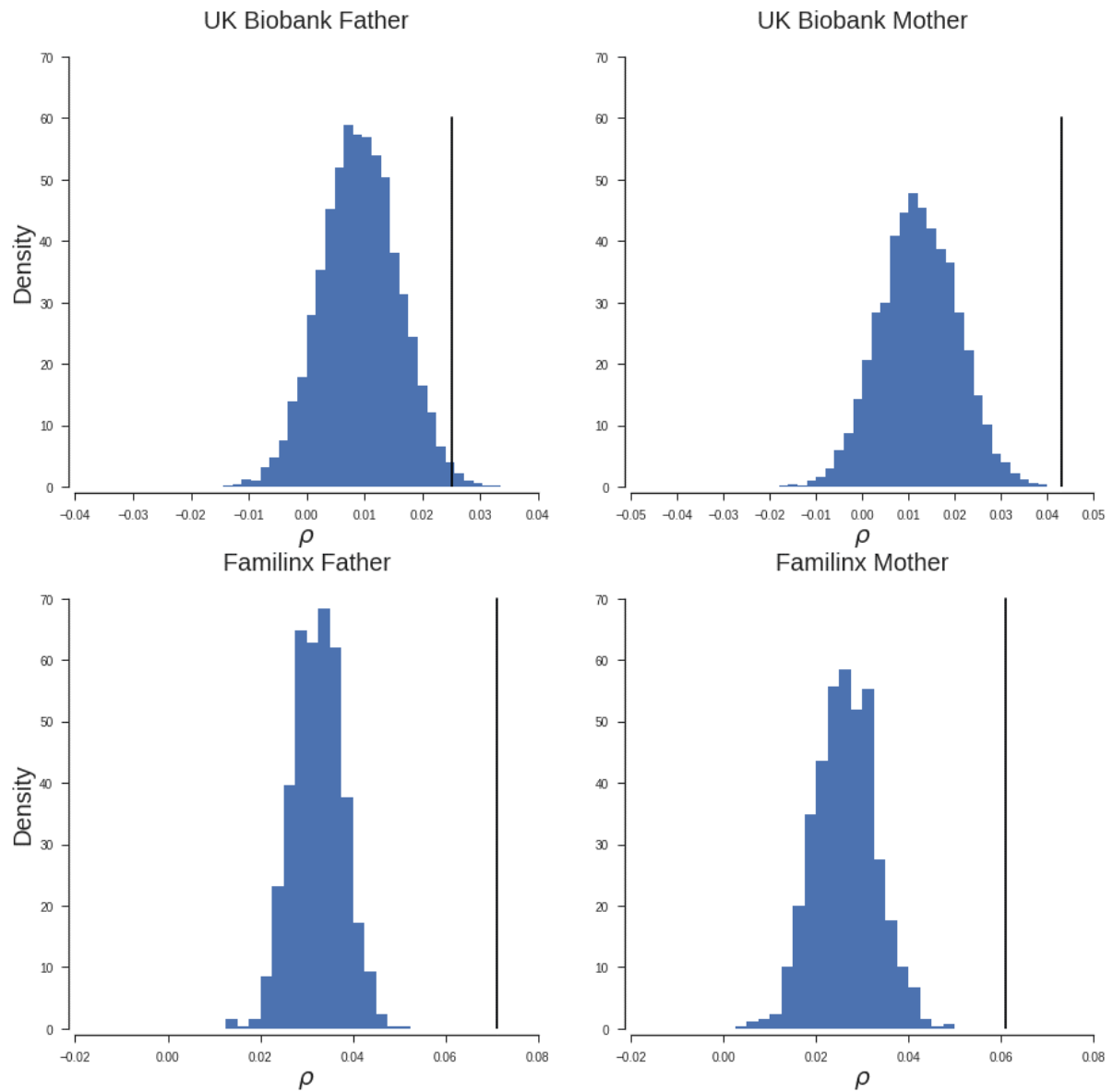


Table S1: Significant ($P < 0.05$) partner phenotypic correlations (ρ_y^{couple}) for potential explanatory variables in couples in the UK Biobank.

		Male Partner					
		Birth Year	Townsend	Height	WHR	BMI	Pack Years
Female Partner	Birth Year	0.91	0.04	0.14	-0.14	-0.01	-0.17
	Townsend	0.04	1.00	-0.07	0.08	0.07	0.14
	Height	0.15	-0.06	0.26	-0.06	-0.04	-0.07
	WHR	-0.15	0.09	-0.06	0.19	0.16	0.11
	BMI	-0.07	0.09	-0.07	0.22	0.24	0.08
	Pack Years	-0.10	0.17	-0.06	0.12	0.09	0.34

Townsend = Townsend Deprivation Index, WHR = Waist to Hip ratio, BMI = Body Mass Index

Table S2: Residual partner correlations in different models of parental longevity in couples in the UK Biobank.

Model	N	Father			Mother			
		ρ	p	%	N	ρ	p	%
Null	22824	0.025	0.01	1.00	15026	0.043	2×10^{-4}	1.00
Birth Info.	22824	0.012	0.21	0.47	15026	0.019	0.10	0.44
All	22824	0.006	0.52	0.25	15026	0.013	0.24	0.32
Individual Factors								
BMI	22824	0.010	0.28	0.40	15026	0.017	0.13	0.41
WHR	22824	0.010	0.28	0.41	15026	0.017	0.14	0.40
Height	22824	0.012	0.21	0.47	15026	0.018	0.11	0.43
Townsend	22824	0.009	0.32	0.38	15026	0.017	0.14	0.39
Pack Years	22824	0.008	0.37	0.34	15026	0.017	0.14	0.39

Null = no covariates, Birth Info.= Birth Year and Birth Location, All = Birth Info and all considered covariates and their squares, Models for individual covariates, contain Birth Info., the covariate and the covariate squared, N = number of couples, ρ = Pearson's correlation of residuals, P = pvalue for $\rho = 0$, % = fraction of ρ under null model remaining

Table S3: Estimates of SNP heritability for parental longevity in the UK Biobank.

	N	h^2	
		estimate	s.e.
Father	79216	0.04	0.005
Mother	64002	0.03	0.006

N = number of individuals used in fitting model, h^2 = heritability

Table S4: Measures of association of family history in all couples in the UK Biobank.

	N	MI	P_{MI}	P_{χ^2}	P_{ρ}	
Father ($\rho_{y^{\sigma^2}inlaws}$)	Heart disease	69751	0.0003	<0.001	1×10^{-10}	6×10^{-11}
	Stroke	69751	0.00006	<0.001	0.0051	0.003
	Lung cancer	68129	0.0001	<0.001	0.0002	1×10^{-4}
	Bowel cancer	68129	0.00004	0.03	0.0169	0.009
	Chronic bronchitis/emphysema	69751	0.00025	<0.001	2×10^{-9}	2×10^{-9}
	Hypertension	69751	0.0011	<0.001	5×10^{-36}	1×10^{-35}
	Diabetes	69751	0.00002	0.11	0.1366	0.067
	Alzheimer's disease/dementia	69751	0.00012	<0.001	2×10^{-5}	2×10^{-5}
	Parkinson's disease	68129	3×10^{-10}	0.5	0.5823	0.267
	Severe depression	68129	0.00001	0.13	0.2193	0.103
	Prostate cancer	68129	0.00005	<0.001	0.0073	0.004
Mother ($\rho_{y^{\sigma^2}inlaws}$)	Heart disease	73308	0.00065	<0.001	7×10^{-23}	9×10^{-23}
	Stroke	73308	0.0003	<0.001	2×10^{-11}	2×10^{-11}
	Lung cancer	72160	0.00012	<0.001	1×10^{-5}	1×10^{-5}
	Bowel cancer	72160	3×10^{-10}	0.57	0.533	0.747
	Breast cancer	72160	1×10^{-10}	0.64	0.667	0.325
	Chronic bronchitis/emphysema	73308	0.0001	<0.001	1×10^{-4}	7×10^{-5}
	Hypertension	73308	0.00111	<0.001	1×10^{-37}	7×10^{-38}
	Diabetes	73308	0.00007	<0.001	0.001	0.001
	Alzheimer's disease/dementia	73308	0.00035	<0.001	1×10^{-13}	3×10^{-13}
	Parkinson's disease	72160	0.00001	0.33	0.297	0.13
	Severe depression	72160	0.00005	<0.001	0.009	0.005

N=Number of Couples, MI = Mutual Information, P_{MI} = empirical permutation based P value based on MI, P_{χ^2} = Chi Squared test P value, P_{ρ} = P value for polychoric correlations

Table S5: Measures of association of family history in couples of self-reported controls in the UK Biobank.

	N	MI	P_{MI}	P_{χ^2}	
Father ($\rho_y^{\sigma^2 \text{inlaws}}$)	Heart disease	47786	0.00019	<0.001	2×10^{-5}
	Stroke	56239	0.00004	0.01	0.037
	Lung cancer	57571	0.00009	<0.001	0.002
	Bowel cancer	56869	0.00006	0.01	0.009
	Chronic bronchitis/emphysema	55905	0.00020	<0.001	2×10^{-6}
	Hypertension	29573	0.00151	<0.001	7×10^{-22}
	Diabetes	52964	2×10^{-7}	0.76	0.907
	Alzheimer's disease/dementia	58008	0.00012	<0.001	1×10^{-4}
	Parkinson's disease	57408	1×10^{-6}	0.71	0.741
	Severe depression	50056	0.00002	0.17	0.181
	Prostate cancer	56596	0.00007	<0.001	0.006
Mother ($\rho_y^{\sigma^2 \text{inlaws}}$)	Heart disease	47786	0.00053	<0.001	8×10^{-13}
	Stroke	56239	0.00029	<0.001	6×10^{-9}
	Lung cancer	57571	0.00014	<0.001	3×10^{-5}
	Bowel cancer	56869	4×10^{-6}	0.45	0.514
	Breast cancer	55075	3×10^{-7}	0.81	0.868
	Chronic bronchitis/emphysema	55905	0.00007	<0.001	0.003
	Hypertension	29573	0.00096	<0.001	4×10^{-14}
	Diabetes	52964	0.00003	0.09	0.091
	Alzheimer's disease/dementia	58008	0.00038	<0.001	7×10^{-12}
	Parkinson's disease	57408	0.00001	0.32	0.331
	Severe depression	50056	0.00005	<0.001	0.025

N=Number of Couples, MI = Mutual Information, P_{MI} = empirical permutation based P value based on MI, P_{χ^2} = Chi Squared test P value

Table S6: Empirical P values for observed association of family history in UK Biobank couples compared to null distribution based on fictitious couples with matched mating structure based on year and place of birth.

	Father	Mother
Alzheimer's disease/dementia	0.0026	<0.0001
Bowel cancer	0.0408	0.8155
Breast cancer	-	0.2781
Chronic bronchitis/emphysema	<0.0001	0.0041
Diabetes	0.8072	0.1212
Heart disease	<0.0001	<0.0001
Hypertension	<0.0001	<0.0001
Lung cancer	0.0316	0.0002
Parkinson's disease	0.8469	0.3366
Prostate cancer	0.0149	-
Severe depression	0.0732	0.0344
Stroke	0.0441	0.0074

Table S7: Empirical P values for observed association of family history in UK Biobank couples compared to null distribution based on fictitious couples with matched mating structure based on participants' or parents' year of birth.

	Father		Mother	
	Offspring	Parent	Offspring	Parent
Alzheimer's	0.007	0.026	0.315	0.356
Bowel cancer	0.34	0.154	0.675	0.687
Breast cancer			0.629	0.67
Chronic bronchitis	0.616	0.732	0.012	0.01
Diabetes	0.171	0.186	0.325	0.312
Heart disease	0.029	0.021	0.156	0.093
Hypertension	<0.001	<0.001	0.001	<0.001
Lung cancer	0.034	0.038	0.018	0.013
Parkinson's disease	0.413	0.127	0.412	0.411
Prostate cancer	0.475	0.439		
Severe depression	0.685	0.695	0.033	0.032
Stroke	0.871	0.888	0.112	0.128

Table S8: Estimates of SNP heritability for parental family history of disease of UK

Biobank participants.

		Controls	Cases	h^2		h_e^2	
				est.	s.e.	est.	95% CI
Father	Heart disease	69,745	31,053	0.033	0.004	0.05	0.04-0.06
	Stroke	86,219	14,579	0.005	0.0037	0.01	0.00-0.03
	Lung cancer	90,372	9,088	0.009	0.0034	0.03	0.01-0.05
	Bowel cancer	93,880	5,580	0.012	0.0038	0.05	0.02-0.08
	Breast cancer	-	-	-	-	-	-
	Chronic bronchitis/emphysema	89,434	11,364	0.022	0.0039	0.06	0.04-0.08
	Hypertension	79,773	21,025	0.024	0.004	0.04	0.03-0.06
	Diabetes	91,804	8,994	0.026	0.004	0.08	0.05-0.10
	Alzheimer's disease/dementia	96,295	4,503	0.008	0.0036	0.04	0.00-0.07
	Parkinson's disease	97,142	2,318	0.003	0.0035	0.02	0.00-0.07
	Severe depression	95,986	3,474	0.008	0.0035	0.04	0.01-0.08
	Prostate cancer	92,526	6,934	0.001	0.0028	0.005	0.00-0.02
	Mother	Heart disease	83,680	20,117	0.016	0.0036	0.03
Stroke		89,469	14,328	0.006	0.0034	0.01	0.00-0.03
Lung cancer		98,437	4,366	0.008	0.0034	0.04	0.01-0.07
Bowel cancer		97,576	5,227	0.012	0.0037	0.05	0.02-0.08
Breast cancer		94,606	8,197	0.019	0.0038	0.06	0.04-0.09
Chronic bronchitis/emphysema		97,417	6,380	0.014	0.0037	0.05	0.03-0.08
Hypertension		73,402	30,395	0.031	0.0039	0.05	0.04-0.06
Diabetes		94,316	9,481	0.03	0.0039	0.09	0.07-0.11
Alzheimer's disease/dementia		95,336	8,461	0.022	0.0038	0.07	0.05-0.09
Parkinson's disease		101,229	1,574	0.001	0.0033	0.01	0.00-0.08
Severe depression		96,333	6,470	0.009	0.0037	0.03	0.01-0.06
Prostate cancer		-	-	-	-	-	-

Controls/Cases= number of controls and cases used to fit the model, h^2 = heritability on the observed scale, h_e^2 =

heritability on the liability scale

Table S9: Within couple correlations of genetic values (ρ_g^{couple}) for family history in genotyped couples in the UK Biobank, based on genetic effects adjusted for birth year, birth location and parent's age.

	Paternal		Maternal		Combined [†]	
	ρ	P	ρ	P	ρ	P
Heart disease	0.011	0.28	0.016	0.11	0.013	0.03
Stroke	0	0.97	0.02	0.05	0.010	0.17
Lung cancer	-0.007	0.47	0.012	0.22	0.002	0.40
Bowel cancer	-0.001	0.93	-0.016	0.11	-0.008	0.13
Breast cancer	-	-	-0.003	0.77	-	-
Chronic bronchitis/emphysema	-0.003	0.79	0.03	0.003	0.014	0.20
Hypertension	0.023	0.02	0.028	0.005	0.025	1.7×10^{-4}
Diabetes	0.004	0.7	0.008	0.41	0.006	0.20
Alzheimer's disease/dementia	-0.002	0.86	0.002	0.83	0.000	0.49
Parkinson's disease	-0.001	0.89	-0.001	0.93	-0.001	0.43
Severe depression	0.015	0.12	-0.008	0.43	0.004	0.37
Prostate cancer	0.007	0.46	-	-	-	-

[†]meta-analysis of paternal and maternal correlations, ρ = Pearson's correlation of residuals, P = pvalue for $\rho=0$

Table S10: Within couple correlations of genetic values (ρ_g^{couple}) for family history, separate for maternal and paternal family history, in genotyped couples in the UK Biobank.

	Paternal			Maternal		
	ρ	95% CI	<i>P</i>	ρ	95% CI	<i>P</i>
Heart disease	0.013	-0.006-0.033	0.18	0.02	0.000-0.040	0.05
Stroke	0.002	-0.018-0.021	0.85	0.024	0.005-0.044	0.01
Lung cancer	-0.006	-0.025-0.014	0.56	0.016	-0.004-0.035	0.12
Bowel cancer	-0.001	-0.020-0.019	0.95	-0.016	-0.36-0.003	0.1
Breast cancer	-	-	-	-0.004	-0.023-0.015	0.68
Chronic bronchitis	0.006	-0.013-0.026	0.52	0.032	0.013-0.052	0.001
Hypertension	0.03	0.011-0.050	0.002	0.03	0.011-0.050	0.002
Diabetes	0.009	-0.011-0.028	0.37	0.01	-0.010-0.029	0.32
Alzheimer's	0.001	-0.18-0.021	0.9	0.007	-0.012-0.027	0.45
Parkinson's	-0.002	-0.022-0.017	0.82	-0.001	-0.020-0.019	0.95
Severe depression	0.017	-0.003-0.036	0.1	-0.01	-0.030-0.009	0.3
Prostate cancer	0.009	-0.010-0.029	0.34	-	-	-

ρ = Pearson's correlation of residuals, *P* = pvalue for $\rho=0$