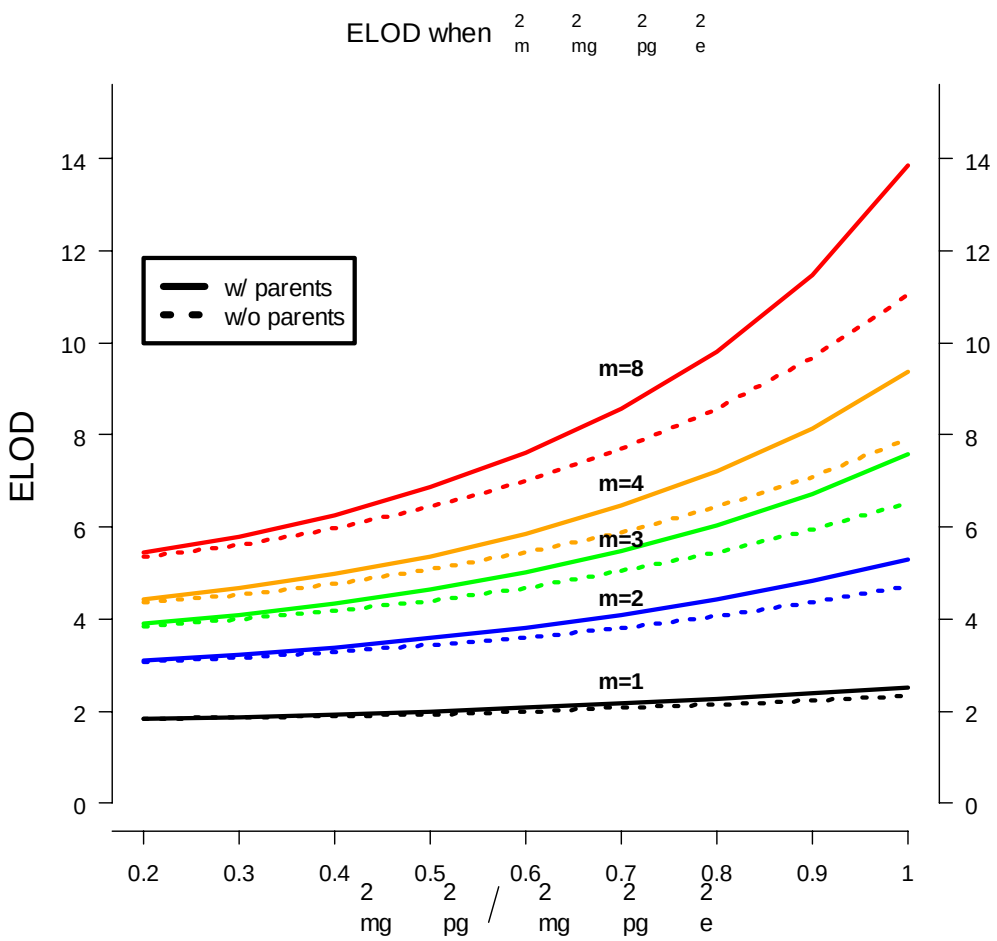
ELOD when σ^2_m σ^2_{mg} σ^2_{pg} σ^2_e
ELOD
w/ parents
w/o parents
m=8
m=4
m=3
m=2
m=1
0
2
4
6
8
10
12
14
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
σ^2_{mg} σ^2_{pg} / σ^2_{mg} σ^2_{pg} σ^2_e

Supplementary Figure 1. Expected LOD score for 1000 nuclear families with 4 offspring with and without using parental phenotypes, where $\sigma^2_{mg} = 0.2$ (10% total variance), $\sigma^2_{pg} = 0,...,0.8$ (0-40% total variance), $\sigma^2_e = 0.8 - \sigma^2_{pg}$ and $\sigma^2_m = \sigma^2_{mg} + \sigma^2_{pg} + \sigma^2_e = 1$ (50% total variance). m = the number of repeated measures.

Supplementary Table 1. ELOD ratios across different pedigree structures

	2sibs		4sibs		6sibs		cousin	
m	ELOD	ratio	ELOD	ratio	ELOD	ratio	ELOD	ratio
1	0.841		2.841		5.065		3.738	
2	1.367	1.626	4.824	1.698	8.530	1.684	6.029	1.613
4	1.841	2.190	6.566	2.311	11.847	2.339	8.119	2.172
8	2.206	2.624	7.977	2.808	14.274	2.818	9.731	2.603

The ratio is comparing the ELOD for m=2, 4, 8 with m=1. We simulated nuclear families with 2, 4, 6 offspring, and a family structure with 2 2nd-generation offspring and each has three 3rd generation offspring (the "cousin" scenario). The total number of individuals in all scenarios was set to the same so as to facilitate power comparison between different family structures. We fixed $\sigma^2_{mg} + \sigma^2_{pg} + \sigma^2_e = 100$, σ^2_{pg} = 40 (24% total variance), σ^2_m = 67 (40% total variance) and simulated a fully informative marker with σ^2_{mg} =20 (12% total variance).

Supplementary Table 2. Power lost and Type I error when ignoring imbalance

	Power						Type I error	
	ELOD			% pvalue < 0.001			% pvalue < 0.05	
m	Correct average model	Ignores the number of measurements	Ratio of ELOD	Correct average model	Ignore the number of measurements	Difference	Correct average model	Ignore the number of measurements
2	3.76	3.64	1.03	82.5%	80.6%	1.9%	4.8%	4.8%
4	4.54	4.16	1.09	90.8%	87.5%	3.4%	4.4%	4.7%
10	5.17	4.49	1.15	95.0%	90.5%	4.5%	3.7%	4.6%

Half of the samples are randomly selected to take a specific number of repeated measures (m=2, 4 or 10), other samples will be measured only one time. Results are based on 2000 simulations. We fixed $\sigma^2_{mg} + \sigma^2_{pg} + \sigma^2_e = 100$, σ^2_{pg} = 40 (24% total variance) and σ^2_m = 67 (40% total variance). In the simulation for power, at a fully informative marker, σ^2_{mg} =20 (12% total variance); in the simulation for type I error, σ^2_{mg} =0.