**Supplemental Material**

**Non-WEIRD studies about birth order effects on intelligence, educational attainment, and personality**

**Table S1**

*Previous Non-WEIRD Studies About Birth-Order Effects on Intelligence, Educational Attainment, and Big Five*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Study** | **Country**  **Sample** | **Outcomes** | **Main analysis**  **Covariates** | **Effect** |
| Abdel-Khalek & Lynn (2008) | Kuwait  *N* = 4,643 | Intelligence  Standard progressive matrices | Between-family analysis:  Sibship size | null |
| Calimeris & Peters (2017) | Indonesia  *N* = 13,444 | Intelligence  Raven’s matrices,numerical test | Within-family analysis:  Education, gender, birth year, test version, size of house, value of assets, number of older / younger siblings, multiple birth | negative |
| Davis et al. (1976) | Israel  *N* = 191,993 | Intelligence  Raven’s matrices | Between-family analysis:  Sibship size, ethnicity | parabolic |
| Munroe & Munroe (1983) | Kenya  *N* = 1,400 | Intelligence  Memory, pattern completion, block design | Between-family analysis:  No covariates | negative |
| Velandia et al. (1978) | Colombia  *N* = 36,000 | Intelligence  Verbal and mathematical aptitude, abstract reasoning | Between-family analysis:  Sibship size | parabolic |
| Wilson et al. (1990) | Zimbabwe  *N* = 1,143 | Intelligence  Cattell’s B scale | Between-family analysis:  No covariates | negative |
| Dayioğlu et al. (2009) | Turkey  *N* = 1,733 | Educational attainment | Within-family analysis:  Mother’s age at first marriage, mother’s age, mother’s schooling, father’s schooling, absent father, marital status of the mother, 5 country regions, city residence and its population, ethnic background of the child | parabolic |
| Ejrnæs & Pörtner (2004) | Philippines  *N* = 790 | Educational attainment | Within-family analysis:  Gender, year of birth | positive |
| Emerson & Souza (2008) | Brazil  *N* = 52,365 | Educational attainment | Effects of family variables (e.g., sibship size, birth order) on educational attainment | positive |
| Park & Chung (2012) | Bangladesh  *N* = 4,182 | Educational attainment | Effect of sibship size on educational attainment based on birth order position | positive |
| Tenikue & Verheyden (2010) | 12 African countries  *N* = 95,188 | Educational attainment | Between- and within-family analysis:  Household wealth | positive but only in poorer families |
| Begum et al. (1981) | India  *N* = 144 | Personality  Personal preferences | Between-family analysis:  Gender | positive and antiparabolic |
| Kaur & Dheer (1982) | India  *N* = 90 | Personality  Emotional stability | Between-family analysis:  No information | antiparabolic |
| Sethi & Gupta (1973) | India  *N* = 1,000 | Personality  Psychosomatic disorder | Between-family analysis:  No information | negative |
| Sharma (1987) | India  *N* = 180 | Personality  Personality problems | Between-family analysis:  No information | negative |

*Note.* Studies for personality outcomes based on Indian samples (Begum et al., 1981; Kaur & Dheer, 1982; Sethi & Gupta, 1973; Sharma, 1987) were no longer accessible to us. The information in the table is based solely on the abstracts.

**Multiple imputation**

**Table S2**

*Variables Used for Multiple Imputation.*

|  |  |
| --- | --- |
| Type of variable | Additional used for multiple imputation |
| Grouping variable | Mother’s ID |
| Covariates | Age[[1]](#footnote-0); Gender |
| Birth order and sibling count | Naive birth order |
| Naive sibling count  Naive birth order and sibling count (interaction) |
| Full birth order |
| Full sibling count  Full birth order and sibling count (interaction) |
| Intelligence | Raven’s matrices test for older participants 2015 |
| Raven’s matrices test for younger participants 2015 |
| Raven’s matrices test for older participants 2007 |
| Raven’s matrices test for younger participants 2007 |
| Math test for younger participants 2015 |
| Math test for older participants 2007 |
| Math test for younger participants 2007 |
| Counting backwards |
| Intelligence | Delayed word recall test |
| Adaptive number series test |
| Education | Years of education |
| Big Five | Extraversion |
| Neuroticism |
| Conscientiousness |
| Agreeableness |
| Openness |

**Birth Order Effects on Additional Outcomes**

**Table S3**

*Model Comparisons for Birth Order Effects on Income, Self Employment, Smoking Behavior,*

*Working Category, and Working Sector*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Model Comparison | | | | |
| Outcome | Model | AIC | BIC | *X2* | *df* | *p* |
| Income Last Year  *n* = 2,477 individuals in 1,868 families | Covariates | 7066 | 7130 |  |  |  |
| Linear birth order | 7067 | 7137 | 0.43 | 1 | .51 |
| Categorical birth order | 7070 | 7163 | 4.87 | 4 | .30 |
| Interaction | 7082 | 7233 | 8.76 | 10 | .56 |
| Self Employment  *n* = 3,763 individuals in 2,561 families | Covariates | 3861 | 3930 |  |  |  |
| Linear birth order | 3863 | 3938 | 0.06 | 1 | .80 |
| Categorical birth order | 3870 | 3969 | 1.33 | 4 | .86 |
| Interaction | 3882 | 4044 | 8.08 | 10 | .62 |
| Smoking Behaviour  *n* = 6,104 individuals in 3,814 families | Covariates | 4133 | 4207 |  |  |  |
| Linear birth order | 4135 | 4216 | 0.00 | 1 | .9996 |
| Categorical birth order | 4140 | 4248 | 3.09 | 4 | .54 |
| Interaction | 4153 | 4327 | 7.75 | 10 | .65 |
|  |  |  |  |  |  |  |
| Working Category  Casual Worker in Agriculture  *n* = 3,763 individuals in 2,561 families | Covariates | -5181 | -5113 |  |  |  |
| Linear birth order | -5180 | -5105 | 0.42 | 1 | .52 |
| Categorical birth order | -5177 | -5077 | 4.74 | 4 | .32 |
| Interaction | -5171 | -5009 | 14.04 | 10 | .17 |
| Working Category  Casual Worker not in Agriculture  *n* = 3,763 individuals in 2,561 families | Covariates | 705 | 774 |  |  |  |
| Linear birth order | 707 | 782 | 0.13 | 1 | .72 |
| Categorical birth order | 714 | 813 | 1.78 | 4 | .78 |
| Interaction | 721 | 883 | 12.58 | 10 | .25 |
| Working Category  Government Worker  *n* = 3,763 individuals in 2,561 families | Covariates | 608 | 677 |  |  |  |
| Linear birth order | 609 | 684 | 1.24 | 1 | .26 |
| Categorical birth order | 615 | 714 | 2.28 | 4 | .68 |
| Interaction | 628 | 790 | 6.89 | 10 | .74 |
| Working Category  Private Worker  *n* = 3,763 individuals in 2,561 families | Covariates | 5279 | 5348 |  |  |  |
| Linear birth order | 5281 | 5356 | 0.16 | 1 | .69 |
| Categorical birth order | 5286 | 5386 | 2.91 | 4 | .57 |
| Interaction | 5299 | 5461 | 6.61 | 10 | .76 |
| Working Category  Self Employment  *n* = 3,763 individuals in 2,561 families | Covariates | 3861 | 3930 |  |  |  |
| Linear birth order | 3863 | 3938 | 0.06 | 1 | .80 |
| Categorical birth order | 3870 | 3969 | 1.33 | 4 | .86 |
| Interaction | 3882 | 4044 | 8.08 | 10 | .62 |
| Working Category  Unpaid Family Worker  *n* = 3,763 individuals in 2,561 families | Covariates | 1344 | 1413 |  |  |  |
| Linear birth order | 1345 | 1420 | 0.80 | 1 | .37 |
| Categorical birth order | 1348 | 1448 | 4.71 | 4 | .32 |
| Interaction | 1362 | 1524 | 6.09 | 10 | .81 |
|  |  |  |  |  |  |  |
| Working Sector  Agriculture, Forestry, Fishing, and Hunting  *n* = 3,610 individuals in 2,484 families | Covariates | 3231 | 3300 |  |  |  |
| Linear birth order | 3233 | 3307 | 0.66 | 1 | .42 |
| Categorical birth order | 3232 | 3331 | 8.95 | 4 | .06 |
| Interaction | 3241 | 3402 | 10.51 | 10 | .40 |
| Working Sector  Construction  *n* = 3,610 individuals in 2,484 families | Covariates | -13505 | -13437 |  |  |  |
| Linear birth order | -13503 | -13429 | 0.10 | 1 | .75 |
| Categorical birth order | -13500 | -13401 | 5.51 | 4 | .24 |
| Interaction | -13485 | -13324 | 4.41 | 10 | .93 |
| Working Sector  Electricity, Gas, and Water  *n* = 3,610 individuals in 2,484 families | Covariates | -4839 | -4771 |  |  |  |
| Linear birth order | -4837 | -4762 | 0.05 | 1 | .82 |
| Categorical birth order | -4882 | -4732 | 2.87 | 4 | .58 |
| Interaction | -4817 | -4656 | 5.40 | 10 | .86 |
| Working Sector  Finance, Insurance, Real Estate, and Business Service  *n* = 3,610 individuals in 2,484 families | Covariates | 4263 | 4331 |  |  |  |
| Linear birth order | 4264 | 4339 | 0.22 | 1 | .64 |
| Categorical birth order | 4270 | 4369 | 2.60 | 4 | .63 |
| Interaction | 4248 | 4445 | 5.55 | 10 | .85 |
| Working Sector  Manufacturing  *n* = 3,610 individuals in 2,484 families | Covariates | 4169 | 4264 |  |  |  |
| Linear birth order | 4198 | 4272 | 0.28 | 1 | .60 |
| Categorical birth order | 4203 | 4302 | 3.11 | 4 | .54 |
| Interaction | 4219 | 4380 | 3.50 | 10 | .97 |
| Working Sector  Mining and Quarrying  *n* = 3,610 individuals in 2,484 families | Covariates | -2965 | -2897 |  |  |  |
| Linear birth order | -2963 | -2889 | 0.71 | 1 | .40 |
| Categorical birth order | -2960 | -2861 | 4.90 | 4 | .30 |
| Interaction | -2944 | -2783 | 3.89 | 10 | .95 |
| Working Sector  Social Services  *n* = 3,610 individuals in 2,484 families | Covariates | -291 | -223 |  |  |  |
| Linear birth order | -289 | -215 | 0.63 | 1 | .43 |
| Categorical birth order | -283 | -184 | 1.53 | 4 | .82 |
| Interaction | -273 | -112 | 10.08 | 10 | .43 |
| Working Sector  Transportation, Storage, and Communication  *n* = 3,610 individuals in 2,484 families | Covariates | -1911 | -1843 |  |  |  |
| Linear birth order | -1911 | -1837 | 2.17 | 1 | .14 |
| Categorical birth order | -1905 | -1806 | 1.89 | 4 | .76 |
| Interaction | -1893 | -1732 | 7.92 | 10 | .63 |

*Notes*. The covariates model included the categorical effect of sibship size (effects of sibship sizes 2, 3, 4, 5, and over 5), self-reported gender, a third-order polynomial for age, and a family random effect. The linear birth order model added birth order as a linear predictor, the categorical model added birth order as a categorical predictor (effects of birth orders 1, 2, 3, 4, 5, and over 5), and the interaction model included the interaction of the categorical birth order and the categorical sibship size. The linear birth order model was compared to the covariates model, the categorical birth order model was compared to the linear birth order model, and the interaction model was compared to the categorical birth order model. Sample sizes differed slightly because not all individuals completed all outcome measurements. *AIC* = Akaike information criterion, *BIC* = Bayesian information criterion, *df* = degrees of freedom.

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1. Prior to imputation age was standardized before deriving quadratic and cubic polynomials to reduce multicollinearity. Therefore, the regression weights for age effects in the imputed models differ from those in the main analyses, where we retained the unstandardized age variable to better visualise conditional marginal effects. However, birth order and sibship size effects can be compared between main analyses and analyses based on imputed data. [↑](#footnote-ref-0)