

## Short Communication

# Season of Birth and Human Longevity

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**T**HE SEARCH for new strong predictors of human life span is an important approach for understanding why individuals are so different in the duration of their life and for unraveling the mechanisms of human aging and longevity. We report here an unexpected finding that the month of birth is an important predictor for the life expectancy of adult women (30 years and above). In particular, women born in May and December tend to live 3 years longer on average compared to those born in August (significant at  $p \leq 0.001$ ; Fig. 1).

The initial aim of our study was to test the recent claims that there is a trade-off between human longevity and biological fertility in British aristocratic families.<sup>1</sup> For this purpose, we have collected and reanalyzed 4,911 genealogical longevity records for women from European aristocratic families as described elsewhere.<sup>2-4</sup> We used the data for extinct birth cohorts (born in 1800-1880) free of censored observations and tested a long list of potential confounding variables to consider all possible artifacts. The month of birth was among these many variables, supposed to be removed from the analysis after confirmation of its poor predictive value. Surprisingly, and contrary to our expectations, the month of birth proved to be an important predictor of a woman's life span.

Because we are skeptical about the scientific credibility of astrology and horoscopes, we first considered this finding to be a statistical artifact and reanalyzed the data while controlling for the effects of (1) calendar year of birth (to control for historical increase in life ex-

pectancy); (2) maternal life span; (3) paternal life span; (4) maternal age when a person (proband) was born; (5) father's age when a person was born; (6) birth order; (7) nationality (German, British, Russian and others); (8) cause of death (violent versus nonviolent); (9) loss of the father in the formative years of life (before age 20); (10) loss of the mother before age 20; (11) loss of both parents (orphanhood) before age 20. The data were analyzed by multiple regression on dummy variables, which is a very flexible tool to control for effects of both quantitative and qualitative (categorized) variables. Life span of adult women was considered as a dependent variable in multivariate regression with nominal variables using Statistical Product & Software Solutions (Chicago, IL) statistical package. The effects of the months of birth are expressed as a difference from the reference level in August and are point estimates of the differential intercept coefficients adjusted for other variables.

The month of birth remains an important predictor for women's life span, even after adjustment for the effects of all other explanatory variables (Fig. 1). In particular, women born in May (399 cases) lived  $3.61 \pm 0.93$  years longer compared to those born in August ( $t$  ratio = 3.89; significant at  $p < 0.001$ ). The second peak of longevity is observed for women born in December (388 cases), who lived  $3.21 \pm 0.94$  years longer than those born in August ( $t = 3.42$ ;  $p = 0.001$ ).

The fact that such an early circumstance of human life as the month of birth may have a

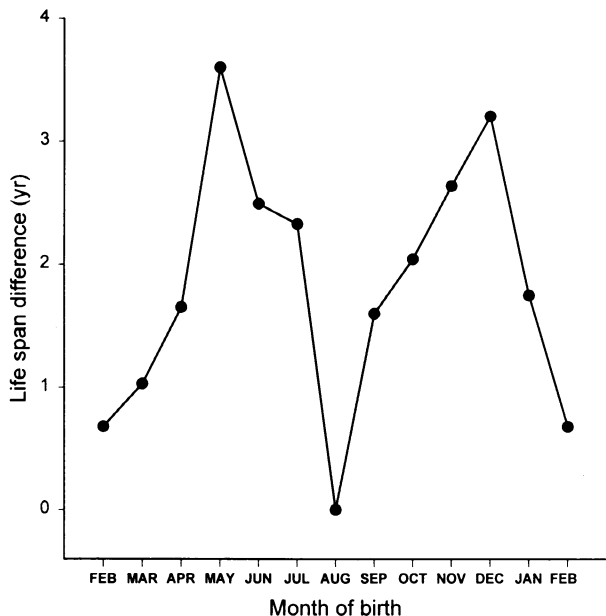


FIG. 1. Life expectancy of adult women (30 years old) as a function of month of birth (expressed as a difference from the reference level in August). The data are point estimates of the differential intercept coefficients adjusted for other variables using multiple regression on dummy variables.

significant effect 30 years later on the chances of human survival is quite remarkable. It indicates that there may be critical periods early in human life particularly sensitive to seasonal variation in living conditions in the past (e.g., vitamin supply, etc.). It is known that the deficiency of folic acid, niacin, and vitamins B<sub>12</sub>, B<sub>6</sub>, C, or E appears to mimic radiation in damaging DNA by causing single- and double-strand breaks, oxidative lesions, or both, and may contribute to premature aging.<sup>5</sup> The seasonal lack of these vitamins in late winter/early spring, in coincidence with one of the two critical periods in child development (the third month of pregnancy and the first months after birth), may explain a dramatic life span shortening among those born in August and February.

Our finding is also consistent with the reliability theory of aging, which emphasizes the importance of the initial level of damage in determining the future length of human life.<sup>6</sup> Further studies are planned and may cast more light on the mysterious links between birth season and human longevity.

### ACKNOWLEDGMENTS

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