

Human Biology *in press*

Dear Editor

We write to point out that digit ratio may be a useful childhood biomarker for endurance running in adults. We have considered this question in a cohort of Jamaican children who have been studied from 1996 to the present day (Trivers et al, 1999).

Digit ratio (2D:4D: the relative lengths of 2<sup>nd</sup> and 4<sup>th</sup> digits) is a negative correlate of prenatal testosterone (Manning et al, 2007). Prenatal testosterone (PT) has organising effects on many traits, and one such is performance in sport. Low 2D:4D (high PT) is linked to endurance sports but it is unclear whether 2D:4D measured in children and teenagers is predictive of their performance when they are adults (Manning et al, 2007).

The purpose of this letter is to consider this question in a long-term study (The Jamaican Symmetry Project: JSP) of participants from a rural Jamaican population (Trivers et al, 1999). The JSP consists of a cohort of 288 children (155 boys), that were first measured in 1996 when participants were 5 to 11 years. The Project focuses on developmental stability, but many other traits have been included. 2D:4D was measured in 1996 from hand X-rays and also from hand photocopies in 2002, and in 2010 for the current study. These measurements afforded us the opportunity to consider a longitudinal study of childhood, teenage and adult 2D:4D as predictors of endurance-related adult performance in sport. We examined the participant's performance in two races (90m and 180m) and focussed on the participants time for the 180m relative to their time for the 90m.

We considered the hypothesis that low 2D:4D is linked to endurance and made the following predictions, (i) participants with low 2D:4D would run faster in the 180m than

expected after consideration of their 90m times. That is, 2D:4D would be positively correlated to 180m times after the influence of 90m times was removed (residuals of 180m times regressed on 90m times: *res180mon90m*), and (ii) this pattern of relationships would not only be found for 2D:4D measured in 2010, but it would also apply to 2D:4D measured in 2002 and 1996.

As our experimental protocol, we ran the first race for each subject (90m) followed by second race (180m) about a ½ hour after the first race. Therefore, any increase in exhaustion from the first race affected the longer, second race, the critical measure being the relative difference between the two. Subjects were run in pairs. With regard to finger measurements, these were made from scans of the ventral surface of the hand.

### **Results**

Means for 2D:4D (SD) are given in Table 1. With regard to sex differences, as expected there was a tendency for males to have lower 2D:4D than females, but this was not significant and the tendency was not found for 1996. There were significant correlations between the means for 2010 and 2002 (right  $r = 0.76$ , left  $r = 0.78$ ), and for 2010 and 1996 (right  $r = 0.46$ , left  $r = 0.51$ ), all at  $p < 0.0001$ . Males ran significantly faster than females for the 90m (males 12.97[1.52] sec., females 17.60[2.90] sec.,  $t = 11.75$ ,  $p < 0.0001$ ) and the 180m (males 28.26[4.80] sec., females 38.80[5.8] sec.,  $t = 12.70$ ,  $p < 0.0001$ ).

We were interested in each participant's relative performance in the 180m run compared to that in the 90m run. Therefore, we considered *res180mon90m* and analysed male and female data separately. We found that 2D:4D was positively related to *res180mon90m* for all correlations. That is, participants with low 2D:4D tended to run faster in the 180m race than was expected after consideration of their 90m times. The correlations varied in strength from  $r = 0.03$  to  $r = 0.26$  across data from all three years. However, the strongest correlations were

found for female right 2D:4D and *res180mon90m* for 2010 ( $r = 0.26, p = 0.02$ ), 2002 ( $r = 0.24, p = 0.045$ ), and 1996 ( $r = 0.20, p = 0.07$ ), all one-tailed tests. However, it is to be noted that there was a tendency for the effect size ( $r^2$ ) of the relationships to reduce in the earlier measurements of 2D:4D (2010  $r^2 = 0.07$ ; 2002  $r^2 = 0.06$ ; 1996  $r^2 = 0.04$ ).

To conclude, we have found that: (i) *res180mon90m* showed positive correlations with 2D:4D. (ii) splitting the correlations by sex and hand we found that right 2D:4D in females was positively and significantly correlated with *res180mon90m*. (iii) 2D:4D measured from photocopies in 2002 and X-rays in 1996 showed a similar pattern with the strongest correlation for right 2D:4D and *res180mon90m* in females. Therefore, low 2D:4D participants had running times over 180m that were faster than expected after considering their times over 90m. We suggest this supports the hypothesis that low 2D:4D is associated with endurance-linked running. The effect was strongest in females and was particularly associated with right 2D:4D. This general pattern was also found in correlations between 2D:4D and running times when the former was measured 8 years and even 14 years before the latter.

We think that such results can be of interest for the readership of *Human Biology* because sustained studies, such as the JSP, that are carried out over a number of years are not common. Furthermore, the 2D:4D represents a relatively simple biomarker for the organising effects of prenatal sex steroids that may have long-term implications for performance in sport and susceptibility to disease in adults.

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Trivers, Robert, Department Ecology, Evolution and Natural Resources, Rutgers University, New Jersey, USA.

Hopp, Renato, Department Pathology, University Estadual Paulista, São Paulo, Brazil.

Manning John, Applied Sports Technology Exercise and Medicine Research Centre, Swansea University, UK.

### References

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Table 1

Mean (SD) for right 2D:4D (R2D:4D) and left 2D:4D (L2D:4D) for males and females measured in 2010 (n = 160; 97 males), 2001 (n = 130; 80 males), and 1996 (n = 146; 88 males).

	Male R2D:4D	Female R2D:4D	<i>t</i>	<i>p</i>	Male L2D:4D	Female L2D:4D	<i>t</i>	<i>p</i>
2010	.937(.035)	.945(.032)	1.45	.15	.939(.032)	.942(.035)	.57	.59
2002	.944(.036)	.952(.034)	1.36	.15	.946(.036)	.952(.036)	1.17	.24
1996	.908(.023)	.904(.022)	.96	.34	.906(.023)	.900(.021)	1.63	.11