

Effect of Altitude on 100-m Sprint Performance

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1. Introduction

- A fair system of recognising athletics records should consider the influence of environmental conditions on performance.
- The International Association of Athletic Federations (IAAF) has placed a 2 m/s wind limit on the sprints and horizontal jumps, but there is currently no restriction on the altitude of the competition venue.
- Mathematical models suggest that sprint performances are enhanced at high-altitude venues (Arsac, 2002). However, the values of some of the biomechanical and physiological coefficients in the models are not well-known and so the magnitudes of the predicted effects are uncertain.

2. Aim

- **To determine the effect of altitude on 100-m sprint performance by comparing race times at the 1968 Olympic Games in Mexico City (altitude 2250 m) to those from sea level Olympic Games.**

3. Method

- Electronic times were obtained for all the 100-m races at the Olympic Games between 1960 and 2004.
- Race times were corrected for the effect of wind (Linthorne, 1994), and the average time of the top-30 athletes in each Olympic Games was calculated.
- The historical improvement in 100-m sprint performance was determined from the world rankings over the last 60 years (Figure 1).
- The improvement in race time due to competing at an altitude of 2250 m was calculated by comparing the average time at the 1968 Olympic Games in Mexico City to the trend line fitted to the other (low-altitude) competition venues (Figure 2).

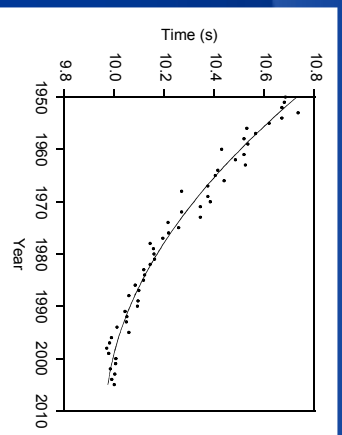


Figure 1. Improvement in world 100-m standards. Data points are the average of the top 20 athletes in each year.

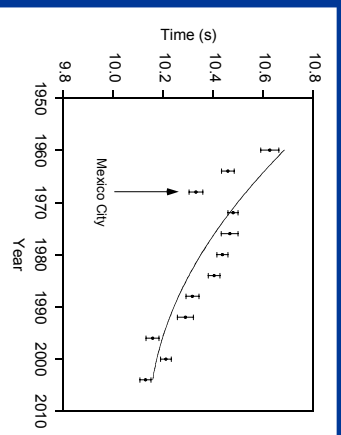


Figure 2. Average 100-m performance by the top 30 athletes in each Olympic Games from 1960 to 2004. The error bars indicate the standard error in the mean, and the fitted curve was constrained to have the same shape as the historical trend in performance shown in Figure 1.

4. Results

- 100-m sprinters derive a substantial performance advantage when competing at a high-altitude venue.
- The time advantage of Mexico City is 0.21 ± 0.03 s for men and 0.16 ± 0.05 s for women.
- The result for the women is less certain than that for the men because of the rapid improvement in sprinting standards during the 1960s and 1970s.
- The results from this study indicate that an altitude of 1000 m provides a time advantage that is equivalent to a 2 m/s tail wind (about 0.10–0.12 s).

5. Conclusion

- Competition venues above 1000 m should not be considered when recognising record performances in the 100-m sprint.
- This would prevent records that have little chance of being bettered at venues close to sea level.

6. References

- Arsac, L.M. (2002). Effects of altitude on the energetics of human best performances in 100 m running: a theoretical analysis. *European Journal of Applied Physiology*, 87, 78–84.
- Linthorne, N.P. (1994). The effect of wind on 100-m sprint times. *Journal of Applied Biomechanics*, 10, 110–131.