Comparison of the World and European Records in the 100m Dash by a Quasi-Physical Model

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Introduction

Background: In major events, such as Olympic Games and World Championships, support staff deliver yet to sprinters reports on their kinematics.

However, quasi-physical models and other analytical procedures [1] may help sprinters having a deeper insight on their performances.

The comparison of the 100m dash by the World and European record holders computing one of these models has not yet been reported.

Aim: To employ a quasi-physical model and analyse the performance and biomechanics of the World and European records in the 100m dash.

Methods

Subjects:

WR
U. Bolt (JAM)
1.96m
94kg
9.58s (v_w+0.9m/s)

ER
F. Obikwelu (POR)
1.95m
80kg
9.86s (v_w+0.6m/s)

Procedures: A quasi-physical model that encompasss a drive (f_s), maintenance (f_m), velocity (f_v) and drag terms normalized to body mass (m) was selected [1]:

$$a = \frac{[(f_s + f_m) - (f_v + f_d)]}{m} \quad (1)$$

The acceleration (eq. 1) was integrated for estimation of the velocity and the latter one again for determination of the distance.

Speed-time [v(t)] or speed-distance [v(d)] of both races were retrieved online and from technical reports [2].

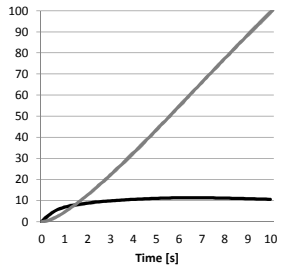

Fig. 1. Integration of the acceleration for estimation of the velocity (in m/s, black line) and distance (in m, grey line).

The final race time (t_c) was also estimated for the event of a null wind speed, based on the wind speed (v_w) and the official race time (t_w) [3]:

$$t_c = t_w \left[1.027 - 0.027 \left(1 - v_w \frac{t_w}{100} \right)^2 \right] \quad (2)$$

Results

Partial contribution of the terms over the race: The f_s is the most important term in the first 5m. Over the 5-40m distance, it is the f_m. Beyond the 40thm mark, f_v is the main determinant. The f_d plays a minor partial role over the entire race.

Bolt (WR) v Obikwelu (ER): Bolt kept f_s for more 2-3m than Obikwelu. The decrease in the f_m is higher in Obikwelu´s race. The f_v and f_d are higher for Bolt. Overall, Obikwelu had a slower start and Bolt a lower deceleration over the race. Bolt´s higher f_d might be related to the speed reached and his anthropometric features.

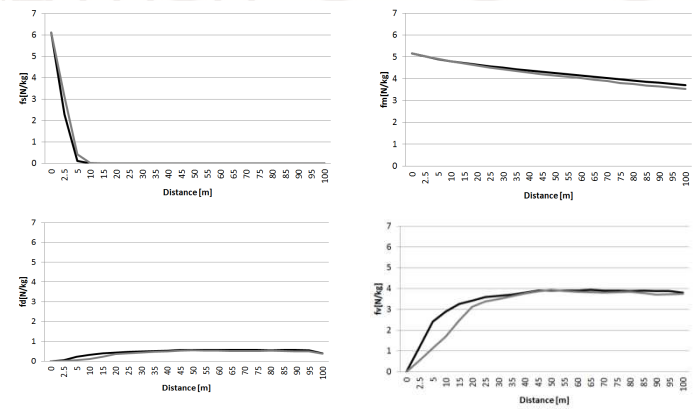

Fig. 2. The drive (f_s), maintenance (f_m), velocity (f_v) and drag (f_d) terms for Usain Bolt (black line) and Francis Obikwelu (grey line) over the 100m dash.

The wind effect:

Table 1. The estimation of the race time (t_c) in the event of null wind speed.

	U. Bolt	F. Obikwelu
t_c [s]	9.62	9.89
Impairment [s]	+0.04	+0.03

Conclusions

It is feasible to employ a quasi-physical model and learn what are the main determinant of a 100m dash performance.

Obikwelu starts slower than Bolt and the Jamaican showed a lower rate of deceleration over the race.

References

[1] Mureika, JR. Canadian J Physics; 2001;79:697-713
[2] Hommel H. Darmstadt: German Athletics Federation; 2009
[3] Mureika JR. arXiv preprint physics/0006057; 2000