A TIME SERIES ANALYSIS OF THE BEST RESULTS OF SPRINT RUNNING IN POLAND BETWEEN 2003-2013

Bartosz **DZIADEK**[A, B, C, E], Krzysztof **PRZEDNOWEK**[C, D, E], Stanisław **CIESZKOWSKI**[D, E, F]

Faculty of Physical Education, University of Rzeszow, Rzeszow, Poland
dziadekbartosz@o2.pl

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Abstract:
In this study, the dynamics of changes in women's and men's sprinting events results was analyzed. The analysis included 10 best results achieved over the period from 2003 to 2013. For the result modeling, the linear trend basic method was used, whereas in order to define the dynamics of the examined phenomenon, one based indexes were determined.

1. INTRODUCTION

The dynamics of results development in individual athletic events does not take a uniform course. In many cases, after a period of a very dynamic development of results in the given event, in the following years a significant deterioration of them can be observed. On the other hand, in other cases, after a long-standing relative stagnation, the following seasons show a radical increase of results.

From the research it follows, that up to the 1990s, the worldwide results in sprinting events both in men and women categories featured an increasing tendency [2, 3, 4].

According to Maszczyk, in the near future, the dynamics of results changes shall improve in those events and the predictable increase shall range from 5% to 13.5%, depending on the gender and distance [2].

The purpose of this study is an attempt to catch the changeability of results in those men's and women's sprinting events in Poland over the period from 2003 to 2013.

2. MATERIAL AND METHODS

The analysis included 10 best results of Polish male and female sprinters over the period from 2003 to 2013. In order to preserve the data uniformity, results achieved in wind direction were excluded from the analysis. Empirical data were obtained from the official website of the Polish Athletic Association [5]. For result modeling, the linear trend basic method was applied:

$$Y = a * t + b$$

where: a - trend value over the period 0, b - average periodic increase (or decrease) of trend, t - time variable.

In order to determine the dynamics of the examined phenomenon, one based indexes were determined, expressed by the formula:

$$i_{t/1} = \frac{y_t}{y_1}$$

where: y_t- average result in time t, y_1- average result in 2003.

3. RESULTS AND DISCUSSION

Presentation of Polish athletes' results was conducted with regard to analysis of changeability over the period from 2003 to 2013. First of all, numerical characteristics of achieved results within the examined event by individual genders was presented (Tab. 1). In addition to that, linear trends for every analyzed event were determined (Tab. 2). Adaptation of theoretical models to empirical data was verified using the determination coefficient R^2. At the next stage of research, one based indexes of dynamics for average results in individual years were determined. As the basis for determination of indexes, the result achieved in 2013 was applied.

Table 1. Characteristic of analysed results

Sport	200m (F)	400m (F)	100m (M)	200m (M)	400m (M)
$\bar{x}$	23.35	52.63	10.35	20.76	45.91
sd	0.11	0.60	0.03	0.15	0.16
V	0.45%	1.14%	0.29%	0.71%	0.35%
min	23.15	51.92	10.31	20.54	45.54
max	23.53	53.53	10.38	20.96	46.09

Table 2. Description of time series models

Sport	Model	R^2
100m (women)	$Y = -0.014t + 39.06$	0.56
200m (women)	$Y = 0.021t + 19.74$	0.45
400m (women)	$Y = 0.12t - 193.1$	0.45
100m (man)	$Y = 0.0006t + 9.1479$	0.003
200m (man)	$Y = 0.013t - 5.49$	0.09
400m (man)	$Y = 0.007t + 31.23$	0.02

3.1. 100M RUN

100m run is a speed event. The athletes practicing that kind of sport feature athletic body type. The champion's model is defined by body built parameters at the following level: body height 185cm and body mass 83.5 [2]. Both in women and men, the distribution of average results over the analyzed period of time is of linear nature (Fig. 1, 2). Linear trends feature small values of directional coefficients reflecting the small tilt of the linear trend straight line.

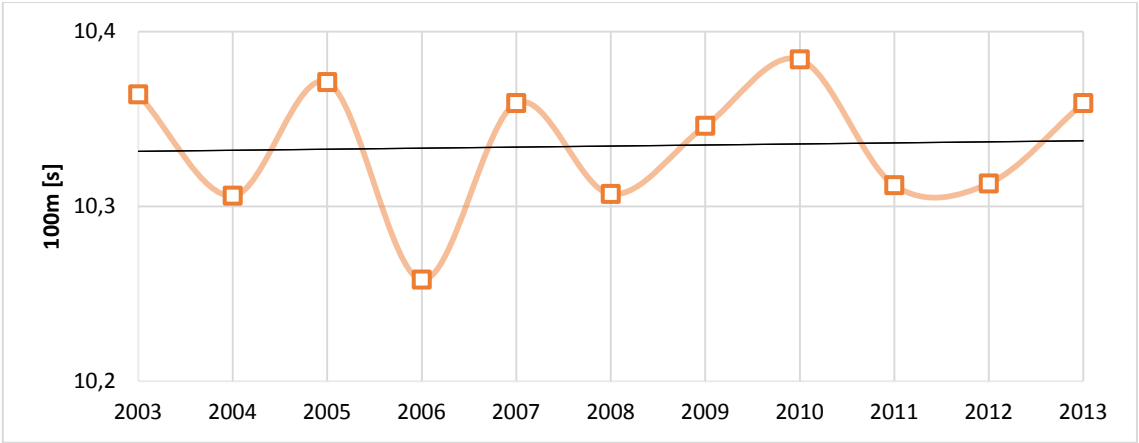

Figure 1. Characteristics of results in 100m run (M)

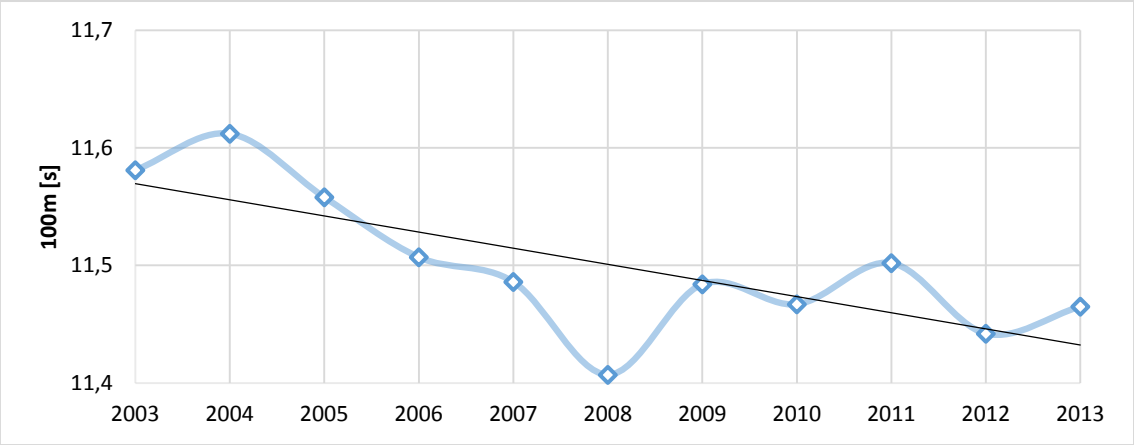

Figure 2. Characteristics of results in 100m run (W)

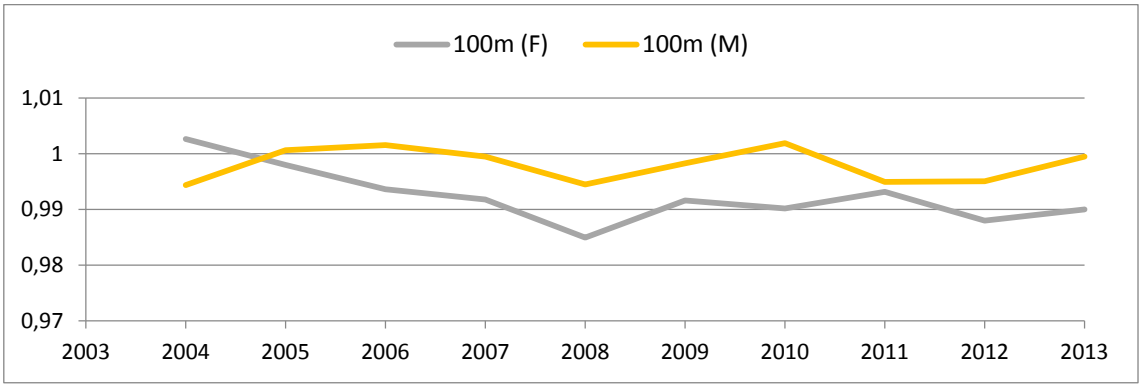

Figure 3. One based indexes in 100m run

From the computed one based indexes (Fig. 3) it follows that the observed dynamics of women's 100m run results over the analyzed period of time featured a continuous decrease of achieved times. That is the evidence of systematical improvement of that event's level. The analyzed dynamics of 100m run results in men showed that changes observed in consecutive years are small.

3.2. 200M RUN

The run over the distance of 200m is an event that, unlike the 100m run, requires from the athlete not only speed but also endurance and an appropriate technique while running through the tight bend. The best result is also largely impacted by the element of running strategy, in which the above circumstances of running through the tight bend (first 100m) and running along the straight line (finishing over the straight 100m leg) shall be optimally exploited [2].

From the analysis of linear trends in men and women over the distance of 200m (Fig. 4 ,5), we conclude that adaptation of linear trend model is significantly more precise in women.

Using computed one based indexes of dynamics (Fig. 6), the dynamics of that phenomenon with regard to the level from the level taken as the basis for comparison (average time in 20013) was illustrated. The analysis of the curves allows for conclusion that up to 2007, the average results achieved within consecutive seasons in women's 200m run were better than the average time taken as the basis for comparison. The following years (except for 2009 and 2010) featured worse average times when compared with results achieved in 2013. In men, time from 2013 was taken as the basis for comparison and it was the best average time over the examined period; therefore, the dynamics of changes at the average

level increased unfavorably. Based on collected data, the medium-term pace of changes was defined. In this case, over 11 years (from 2003 to 2013), the average time of men's and women's 200m run was for both groups respectively worse by approx. 0.04% (M) and 0.03% (W), when compared to the previous year.

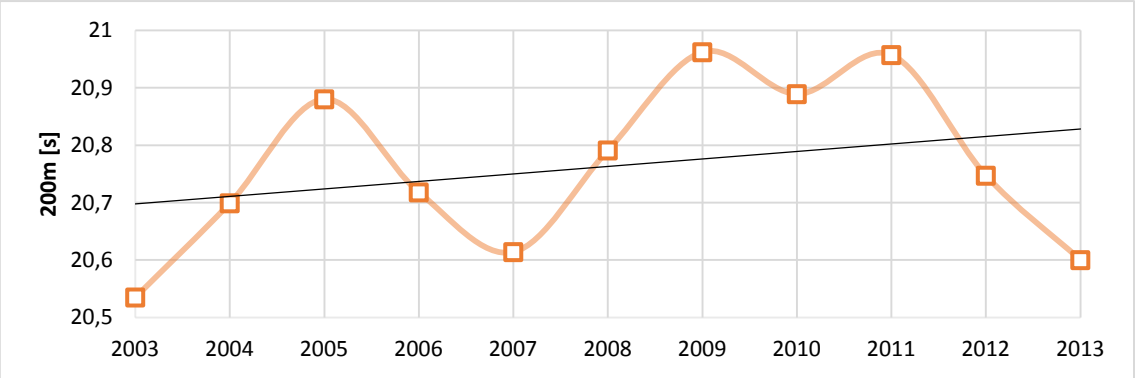

Figure 4. Characteristics of results in 200m run (M)

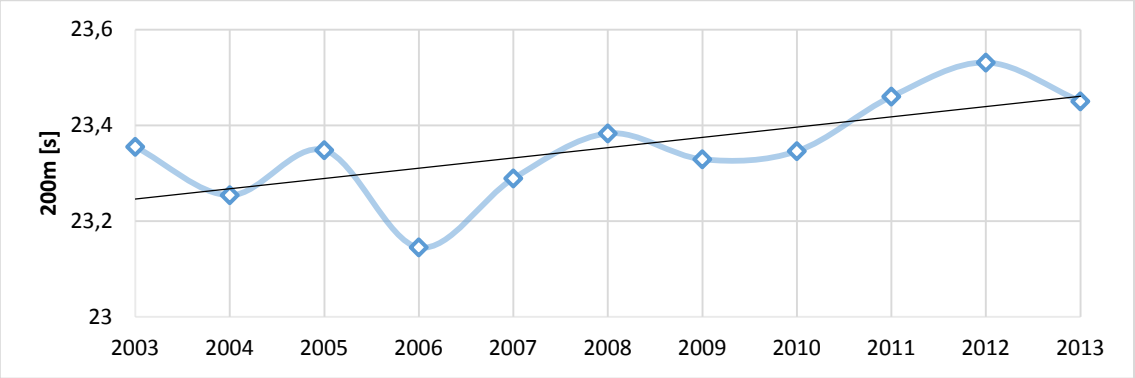

Figure 5. Characteristics of results in 200m run (W)

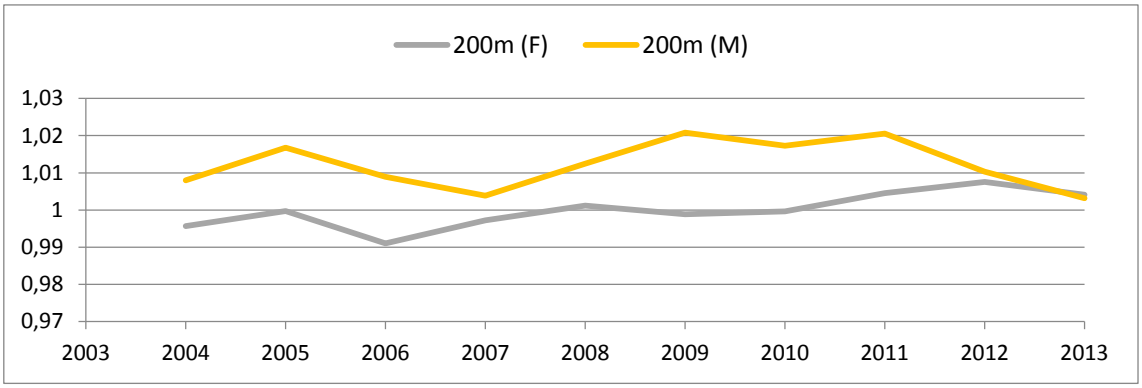

Figure 6. One based indexes in 200m run

3.3. 400M RUN

The 400m run is an event in which the final result is impacted by factors such as athlete's speed and endurance, body built and, to the large extent, the ability to distribute the strength over the whole distance. The distance that the athlete has to cover during the run, requires from him first of all a different running technique and a number of factors associated with it makes the dynamics of that run not as effective as over distances of 100 and 200m [6].

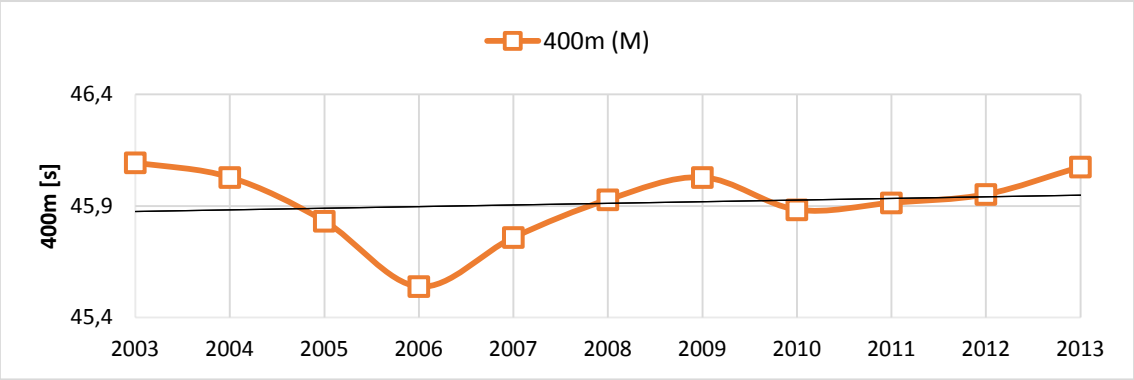

Figure 7. Characteristics of results in 400m run (male)

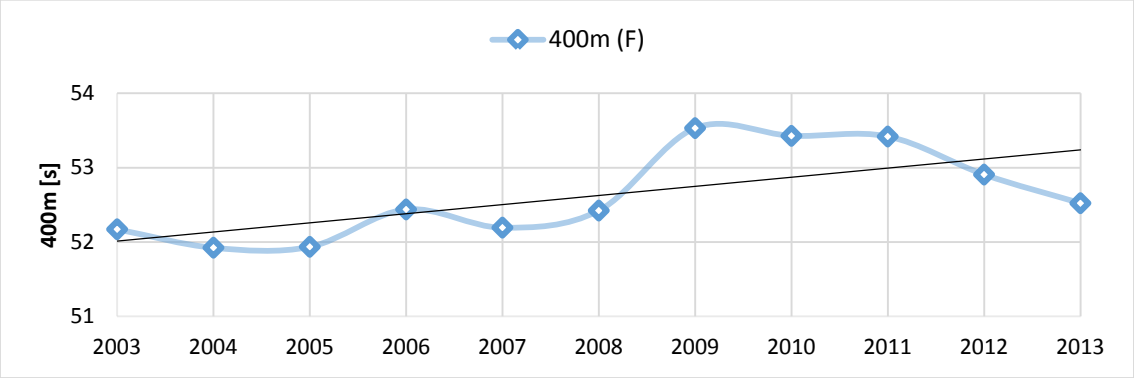

Figure 8. Characteristics of results in 400m run (female)

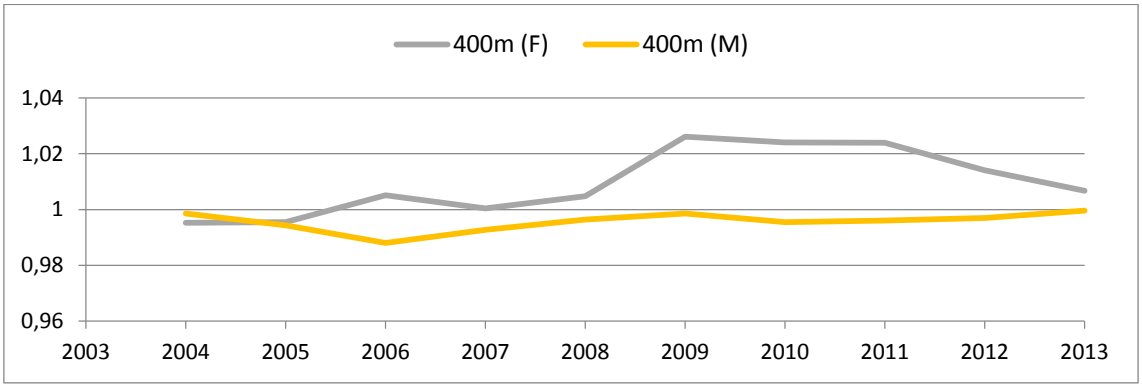

Figure 9. One based indexes in 400m run

Trends presented in the diagram (Fig. 7, 8) show a slight decreasing tendency in both genders. Among women, results below the trend line were obtained during the years 2005, 2007 and the two last seasons. Among men, the linear trend coincides to a large extent with average times over that distance and the best results were noted in 2006. By analyzing the dynamics (the determined one based indexes) relating to achieved average times over the period of time from 20013 to 2013, it can be concluded, that it is significantly lower in men than in women. However, the values of indexes in men over the whole examined period of time are less than one, what reflects the continuous progress in that event. In women, from 2006 on, a decrease of sports performance in relation to times achieved in 2003 can be observed. Based on the analysis of mid-term pace of changes we can conclude, that results achieved by men over the examined period of time are better and better from year to year. In women, the average times achieved during the previous 11 years were worse (on average by 0.06%) compared to the previous year.

4. CONCLUSION

The conducted analysis allows the following conclusions:

- the dynamics of results in women's 100m run featured continuous decrease of achieved results, whereas in men, the observed changes are relatively small.
- the analysis of dynamics of results in men's 200m run showed that from 2003 on there was no improvement of the average result, whereas changes in women can be considered favorable what proves a continuous development of that event.
- the dynamics of results in 400m run showed that results achieved by men improve in consecutive years; on the other hand, in women, over the previous 11 years the results achieved in every following year are worse than those obtained in the previous season.

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