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Original research paper

THE 800 METERS RUNNING SUCCESS DIFFERENCES OF SCHOOL-AGED FEMALE ATHLETES ACCORDING TO MATURITY STAGE

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Abstract. *The aim of this study was to determine the 800 meters running success differences of school-aged female athletes according to maturity stage. The study's sample of respondents consisted of 26 school-aged female athletes who were selected for middle-distance running. The mean chronological age of the respondents was 12.67 ± 1.03 years. The respondents were divided into two groups according to biological maturity: Mid Peak Height Velocity (n = 13; mean chronological age 11.81 ± 0.57 years) and Post Peak Height Velocity (n = 13; mean chronological age 13.54 ± 0.52 years). Based on the results of the Student's T test of independent samples, it could be concluded that there was statistically significant difference in the 800 meters running success of female athletes according to biological maturity. It could be stated that respondents in the Post Peak Height Velocity group were more effective in this middle-distance running athletic discipline than respondents in the Mid Peak Height Velocity group. More specifically, female athletes with earlier stages of maturation dominated middle-distance running. Furthermore, because biological maturity causes differences in physical performance, maturity status should be the foundation of physical performance assessment. These findings can also be applied to the more successful selection of athletes. Trainers should avoid the potential risks associated with investing in athletes who dominate physical performance tests simply because they have matured earlier biologically.*

Key words: *athletics, track and field, middle-distance running, elementary school students, biological maturity*

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1. INTRODUCTION

Athletics is a sport that consists running, jumping, throwing, and sports walking (Timpka et al., 2014). Also, athletics benefits include improved fundamental mobility as well as the development of various movement abilities and skills (Jakubík, & Broďáni, 2023). Maturity of a child can be observed chronologically and biologically (Leite Portella et al., 2017). Chronological maturity can be seen as the period from the child's birth to a specific time point (Prieto, Barbería, Ortega, & Magaña, 2005). However, it is well-established that child development is non-linear with a rapid increase in muscle mass and body weight after peak height velocity (PHV) (Živković et al., 2022). On the other hand, biological maturity is determined by the morphological, anatomical, functional and biochemical status of the organism, which is specific for a certain period of chronological age (Avsiyevich, Plakhuta, & Fyodorov, 2016). There is frequently a disparity between these stages of a child's development, and there are three biological maturity groups in relation to chronological maturity: those who are late in biological maturation compared to their peers, those who develop according to the determinants of chronological maturity and those who are more advanced in biological maturation than their peers (Avsiyevich, Plakhuta, & Fyodorov, 2016). Specifically, there are several differences between children of various ages, particularly in anthropometry (mainly body height), but also in the development of functional and motor abilities (Malina et al., 2004). Finally, it is necessary to provide the opportunity for children to have a certain physical activity in order to assist the development of basic motor abilities and skills (Szabo 2021).

There are no studies that have investigated the success of female athletes in middle-distance running according to maturity stage. However, several studies have examined the development of some basic athletic abilities according to biological maturity (Colyer, Nagahara, Takai, & Salo, 2020; Lefevre et al., 2013; Malina et al., 2010). Colyer, et al., (2020) investigated sprinting ability and the ground reaction force that underpins sprint performance in athletes. It was established that there was an influence of biological maturity on these variables in both boys and girls. More mature children showed better running performance, which may be related to the sudden increase in body height and body mass. On the other hand, the difference in the performance of some athletic abilities (long jump, high jump, sprint, 6-minute endurance race...) according to biological maturity was also established (Lefevre et al., 2013; Malina et al., 2010). Namely, it was established that children who were biologically more mature than their peers showed better physical performance as well as higher values of body height, body mass and muscle mass (Malina et al., 2010).

There are not many published scientific papers that have investigated the biological maturity of athletes. More precisely, there are no studies at all about the school-aged female athletes who practice the athletic discipline of middle-distance running. Therefore, the aim of this study was to determine the 800 meters running success differences of school-aged female athletes according to maturity stage.

2. METHOD

2.1. Sample of respondents

The study's sample of respondents consisted of 26 school-aged female athletes who were selected for middle-distance running. The respondents were regular members of the "Slavonija-Žito" athletics club in Osijek. The mean chronological age of the respondents

was 12.67 ± 1.03 years. The respondents were divided into two groups according to biological maturity: Mid Peak Height Velocity (MidPHV) (n = 13; mean chronological age 11.81 ± 0.57 years) and Post Peak Height Velocity (PostPHV) (n = 13; mean chronological age 13.54 ± 0.52 years). There were no respondents in the Pre Peak Height Velocity (PrePHV) group in this study. All respondents were familiar with the testing protocol and voluntarily participated in it.

2.2. Maturity Assessment

Biological maturity was determined for each respondent based on the formula established by Mirwald, Baxter-Jones, Bailey, & Beunen, (2002). It is an approach to determine the time of peak height velocity (PHV) based on anthropometric measures (body height, leg length and sitting height) and chronological age. The time passed since PHV was calculated using the maturity offset value (in years). Then the maturity offset value was deducted from the chronological age to obtain the precise years when PHV was reached (Maturity age). The respondents were divided into groups based on the Maturity offset value. Respondents with Maturity offset values ranged from -0.5 to 0.5 were assigned to the MidPHV group, while respondents with Maturity offset values over 0.5 were assigned to the PostPHV group (Meyers, Oliver, Hughes, Lloyd, & Cronin, 2017). The maturity offset formula for girls was as follows:

Maturity offset (years) = −9.376 + (0.0001882 × [Leg Length × Sitting Height]) + (0.0022 × [Age × Leg Length]) + (0.005841 × [Age × Sitting Height]) − (0.002658 × [Age × Body Mass]) + (0.07693 × [Body mass : Body height × 100]).

2.3. Procedures

The measurement of anthropometric characteristics was carried out at the athletic stadium before training. The respondents were barefoot during anthropometric measurements. Martin's anthropometer GPM 101 (GPM GmbH Switzerland) with an accuracy of 0.1 cm was used to assess the body height, sitting height and leg length of the respondents. Body mass was taken using an Omron BF511 electric scale (Omron Healthcare Co, Kyoto, Japan) with an accuracy of 0.1 kg. Dehghan & Merchant (2008) previously reported the instrument's reliability and validity. Body mass index was computed as the ratio of body mass in kilograms to body height in meters squared (kg/m2). The respondents' warm-up protocol followed the measurement of anthropometric characteristics. The warm-up protocol consisted of running for 10 minutes as well as static and dynamic stretching exercises.

The 800 meters running time was determined by a handheld stopwatch. Reliability and validity of the instrument was reported by Hetzler, Stickley, Lundquist, & Kimura, (2008). The respondents ran at the athletics stadium, where one lap was 400 meters. The respondents' task was to run two laps from a high start position behind the starting line. The respondents started running at the meter's signal. The meter recorded the running time after the respondents had run the intended distance. The race could only be run by a maximum of five respondents at a time. It was necessary for the respondents to run during the testing as if they were competing.

2.4. Statistical analysis

The IBM SPSS Statistics 20 program was used for the statistical processing of data. The One-Sample Kolmogorov-Smirnov Test was used to determine the normality of the

distribution as well as the descriptive statistics of the monitored variables was presented. Because there were two groups of respondents in this study, the Student's T test of independent samples was used to determine the difference in the 800 meters running success of female athletes according to their biological maturity.

3. RESULTS

Table 1. presents the descriptive statistics of the entire sample of respondents in the following variables: chronological age, PHV, maturity offset, body height, body mass, body mass index, sitting height, leg length and the 800 meters running results. Also, Table 1 contains information about the normality of the distribution based on the results of the One-Sample Kolmogorov-Smirnov Test. On the other hand, Table 2. presents the descriptive statistics of these variables according to PHV groups (MidPHV and PostPHV).

Table 1 Descriptive statistics and distribution normality of the entire sample of respondents

Variables	Mean ± Std. Deviation	One-Sample Kolmogorov-Smirnov Test
Chronological Age	12.67 ± 1.03	0.23
Maturity Age	11.94 ± 0.48	0.75
Maturity offset	0.79 ± 0.96	0.80
BM	48.23 ± 11.84	0.67
BH	160.38 ± 8.47	0.85
SH	81.73 ± 3.61	0.34
LL	78.65 ± 6.39	0.63
BMI	18.58 ± 3.51	0.95
800m (min)	3.60 ± 0.72	0.17

Legend: BM - body mass; BH - body height; SH - sitting height; LL - leg length; BMI – body mass index; 800m – the 800 meters running results.

Based on the results of the Kolmogorov-Smirnov test, the normality of the data distribution in this study could be concluded. Therefore, the Student's T test of independent samples was used to determine the differences in the 800 meters running success of school-aged female athletes (Mid and PostPHV groups) according to biological maturity.

Table 2 Descriptive statistics by groups

Variables	Mean ± Std. Deviation	
	MidPHV	PostPHV
Chronological Age	11.81 ± 0.57	13.54 ± 0.52
Maturity Age	11.99 ± 0,40	11.88 ± 0.55
Maturity offset	-0.02 ± 0.63	1.61 ± 0.29
BM	41.54 ± 8.98	54.93 ± 10.70
BH	155.00 ± 7.44	165.77 ± 5.58
SH	79.46 ± 3.50	84.00 ± 1.91
LL	75.54 ± 5.08	81.77 ± 6.19
BMI	17.18 ± 2.89	19.98 ± 3.62

Legend: MidPHV = Mid Peak Height Velocity; PostPHV = Post Peak Height Velocity; BM - body mass; BH - body height; SH - sitting height; LL - leg length; BMI – body mass index.

Table 3 presents the results of the statistical analysis of the Student's T test of independent samples, as well as the 800-meter running results according to PHV groups.

Table 3 Student's T test of independent samples

	Mean ± Std. Deviation		Student's T test of independent samples
	MidPHV	PostPHV	
800m (min)	3.92 ± 0.84	3.29 ± 0.41	0.025*

Legend: * - statistically significant difference ($p < 0.05$); MidPHV = Mid Peak Height Velocity; PostPHV = Post Peak Height Velocity; 800m - the 800 meters running results.

Based on the Table 3. and the results of the Student's T test of independent samples, it could be concluded that there was statistically significant difference in the 800 meters running success of school-aged female athletes ($p=0.025$) according to biological maturity. It could be stated that respondents in the PostPHV group were more effective in this middle-distance running athletic discipline than respondents in the MidPHV group. More specifically, female athletes with early maturation dominated middle-distance running.

4. DISCUSSION

The aim of this study was to determine the 800 meters running success differences of school-aged female athletes according to maturity stage. According to the findings of this study, there was a statistically significant difference in the 800 meter running success of female athletes based on their biological maturity. Namely, female athletes with earlier maturation were more successful in running this athletic discipline compared to their peers. Furthermore, female athletes in the PostPHV group were not only more effective runners, but they were also better in anthropometric measurements than female athletes in the MidPHV group. Finally, it could be stated that earlier stages of maturation led to a dramatic improvement in body height and mass, as well as superior middle-distance running performance.

Biological maturation is a process that takes place in all physiological problems, systems and organs (Malina, Rogol, Cumming, e Silva, & Figueiredo, 2015). Unfortunately, there are not many scientific papers that have investigated the biological maturity of female athletes. However, it is generally accepted that body mass and height increase with earlier stages of maturation (Živković et al., 2022). Malina et al., (2010) stated in their study that respondents with earlier biological maturity were more dominant in muscle mass, body height and body mass. Also, four tests for assessing motor abilities were performed (handgrip strength, long jump, two kilogram medicine ball throw and 20 meter sprint). Differences in the performance of motor abilities according to the biological maturity of athletes were confirmed. Both boys and girls with an earlier biological maturity performed better in motor ability tests. These findings are consistent with the findings of our investigation. Our data indicated that female athletes with earlier stages of biological maturation ran the 800 meters faster than those with lower stages of biological maturation. Therefore, the trainers are advised not to jump to conclusions and to favor specific athletes who may be more biologically mature than their peers.

Furthermore, Kirkeberg, Roaas, Gundersen, & Dalen, (2022) claimed that biological maturity declines with rising chronological age. Moreover, the findings of their study indicate that biological maturity has a stronger influence on success in explosive athletic disciplines compared to its influence on success in endurance disciplines for both sexes

and all ages. Additionally, Lefevre et al. (2013) indicated that athletes with earlier stages of biological maturity perform better in various athletic events (shot put, high jump, six minute endurance run, and 60 meter sprint). The biological method established that athletic performance in adolescence is predicted by the cumulative contribution of performance progression and somatic growth during early adolescence (Lefevre et al., 2013). These findings are in line with the findings of our study, which found similar results in the area of athletic performance. Finally, it could be suggested that all athletes, both older and younger, should be given similar opportunities for development at an early age, such as equal attention and monitoring.

The study's limitation is the small number of female athletes who practiced middle-distance running. Also, one of the study's major limitations is that there were no PrePHV responders. It is believed that if responders with later maturation had participated in the study, more precise results would have been achieved. Furthermore, the testing was conducted after the competitive season. It is expected that the study would have given even better results if the testing had been conducted during the preparatory period. Due to all the above, the results cannot be generalized or applied to the entire population.

5. CONCLUSION

Based on the results of the study, it could be concluded that there were statistically significant differences in the 800 meters running success of school-aged female athletes according to their biological maturity. More specifically, the success of middle-distance running is influenced by the maturity stage of female athletes. Female athletes with earlier stages of maturation ran the 800 meter event faster. Furthermore, because biological maturity causes differences in physical performance, maturity status should be the foundation of physical performance assessment. These findings can also be applied to the more successful selection of athletes. Therefore, trainers should avoid the potential risks associated with investing in athletes who dominate physical performance tests simply because they have matured earlier biologically.

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RAZLIKE U USPEHU TRČANJA NA 800 METARA KOD ATLETIČARKI ŠKOLSKOG UZRASTA U ODNOSU NA NIVO ZRELOSTI

Cilj ovog istraživanja bio je da se utvrde razlike u uspehu trčanja na 800 metara kod atletičarki školskog uzrasta u odnosu na nivo zrelosti. Uzorak ispitanika sastojao se od 26 atletičarki školskog uzrasta koje su selektovane za trčanje na srednje staze. Srednja hronološka starost ispitanica bila je 12.67 ± 1.03 godina. Ispitanice su bile podeljene u dve grupe prema biološkoj zrelosti: MidPHV (n=13; srednja hronološka starost 11.81 ± 0.57 godina) i PostPHV (n = 13; srednja hronološka starost 13.54 ± 0.52 godina). Na osnovu rezultata Studentovog T testa nezavisnih uzoraka, može se zaključiti da postoji statistički značajna razlika u uspehu trčanja na 800 metara kod atletičarki školskog uzrasta u odnosu na nivo zrelosti. Može se reći da su ispitanice iz grupe PostPHV bile uspešnije u atletskoj disciplini trčanja na srednje staze od ispitanica iz grupe MidPHV. Tačnije, atletičarke koje su ranije sazrele dominirale su u trčanju na srednje staze. Štaviše, pošto biološka zrelost uzrokuje razlike u fizičkim performansama, status zrelosti treba da bude osnova procene fizičkog učinka. Takodje, rezultati studije se mogu koristiti prilikom uspešnije selekcije sportista. Potrebno je da treneri izbegavaju potencijalne rizike povezane sa ulaganjem u sportiste koji dominiraju u realizaciji testova motoričkih sposobnosti samo zato što su ranije biološki sazreli.

Ključne reči: *atletika, trčanje na srednje staze, osnovci, biološka zrelost*