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Motion Kinematic Analysis of the Palestinian Athletics Team Players Under 20 Years in 1500 m Race

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Abstract: This study identifies the kinematic analysis of the Palestinian athletics team players under 20 years in a 1500 m race by calculating the kinematic variables, identifying the relationship between them and the performance stages, and identifying the differences between the kinematic variables of the performance stages and the time of the 1500 m race. The researchers followed the analytical descriptive approach and selected a purposive sample; the Palestinian athletics team players under 20 years who participated in 1500 m races from the southern governorates (i.e. three players). The research main results were identifying the kinematic variables and their values (step length, step frequency, contact time, flight time, step time, step speed, average speed and center of pressure position). There are no statistically significant relationships between the values of the kinematic variables and the 1500 m race time. Statically significant differences at 0.05 are observed for the values of the kinematic variables: step length, contact time, and flight speed. However, there are no statistically significant differences for the values of the other variables. The researchers recommend the Palestine Athletic Federation to benefit from the results of the study for each of the race' stages to identify the strengths and weaknesses of players and hence improve their skills.

Keywords: motion analysis, kinematic analysis, 1500 m race.

巴勒斯坦田径队20岁以下运动员1500米赛跑运动学分析

摘要：本研究通过计算运动学变量，确定它们与表现阶段之间的关系，并确定表现阶段的运动学变量与表现阶段之间的差异，确定了20岁以下巴勒斯坦田径队运动员在1500米比赛中的运动学分析。1500米比赛时间。研究人员遵循分析描述的方法，选择了一个有目的的样本；来自南部省份参加1500米比赛的20岁以下巴勒斯坦田径队运动员（即三名运动员）。研究的主要结果是确定运动学变量及其值（步长、步频、接触时间、飞行时间、步长时间、步速、平均速度和压力中心位置）。运动学变量的值与1500米比赛时间之间没有统计学上的显著关系。对于运动学变量的值观察到0.05的静态显著差异：步长、接触时间和飞行速度。但是，其他变量的值在统计上没有显著差异。研究人员建议巴勒斯坦田径联合会从每个比赛阶



段的研究结果中受益，以确定运动员的长处和短处，从而提高他们的技能。

关键词：运动分析，运动学分析，1500米赛跑。

1. Introduction

Sports conferences have contributed to the introduction of new aspects in the field of scientific research; the most recent of which is the international scientific conference on sport sciences titled “Accelerators of Sports Development in the Third Millennium” convened on 23-24/10/2021 by the Drasa Academy at the Faculty of Physical Education at Alexandria University. The Conference discussed the importance of modern technology and motion analysis in the improvement of the level of motion performance and sports levels to achieve better results.

The availability of full details and information on the performance of players in general, and athletics players in particular during the sports season helps improve the digital level, and thus the attainment of high levels.

The biomechanical analysis of the different basic skills using motion analysis programs contributes to the improvement of the players’ sports performance and their achievements in sports competitions [1].

Temporal resolution was used to improve the players’ training process for different sports skills. The analysis begins with identifying the goal, then using analysis and evaluation to identify the players’ strengths and weaknesses [2].

Both researchers agree that it has become difficult to identify the accurate characteristics of motion analysis due to the development of motion performance, which requires the search for new technologies to identify a player’s performance objectively.

Kinematic analysis addresses the positions and movements of a body in space and time. It registers the accurate time of movements in space [3].

Videotaping is essential to motion analysis as it displays minute details of performance in slow motion [4].

Motion analysis is one of the accurate means to be used in the improvement and development of players. It is a means that enables our access to knowledge, helps uncover small mistakes, and fix them considering performance specifications.

Athletics are deemed special due to the different abilities they cover. It has also shown incredible advancements at the digital level. This advancement reflects the great amount of information that led to it [5].

The usual training method, which depends on the observation, is not enough to pinpoint the details, and so it wastes time and effort. Running and walking are

considered natural sports [6].

This shows an effective protocol for TT behavior and time-motion analysis that can be used during TKD training to increase the effectiveness of high-level athletes [7]. And each stage of the technical stage of the triple jump skill has a relation with and plays a role in identifying the level of accomplishment among the players [8].

The temporal resolution of motion performance of long-jump players identified a relationship between flight time and long-jump competitions [5].

The researchers identified the research problem based on their experiences as former coaches in track competitions. They noticed that the digital level among the athletics Palestinian team players under 20 years in a 1500 m race is consistent. There are big differences between the results of Palestinian players and Arab and international players’ levels. While Tamer Qaoud’s running time reached 4.06 minutes during the 2021 Islamic Solidarity Games that occurred in Turkey, August, 2022; the running time of the Moroccan runner, Abdulatif Sidiki, who won the first place, took only 3.54 minutes.

As a result, the idea of this research emerged. It identified the motion kinematic analysis of the Palestinian athletic players under 20 years in a 1500 m race.

The researchers identified the values of kinematic variables and identified the relationship between these values and the performance stages. The research also identified the differences between the values of the kinematic variables of performance stages and the racing time of 1,500 m by testing the best team players who represented Palestine at several races abroad so that the coaches would design training patterns based on them.

2. Definitions and Abbreviations

2.1. Motion Analysis

This type of science examines performance and seeks to study the elements of motion, and its components with the aim to design better techniques [9].

2.2. Kinematic Analysis

It is the analysis of motion using speed, distance, and time [6].

3. Research Objectives

- 1- Identifying the values of kinematic variables of

the selected performance stages of the 1500 m race for the research sample;

2- Identifying the relationship between the values of the kinematic variables of the performance stages and the racing time of 1,500 m for the research sample;

3- Identifying the differences between the values of the kinematic variables of the performance stages and the racing time of 1,500 m for the research sample.

4. Research Questions

1- What are the values of the kinematic variables of the selected performance stages of the 1500 m race for the research sample?

2- Is there a relationship between the values of the kinematic variables of the performance stages and the racing time of 1,500 m for the research sample?

3- Are there any differences between the values of the kinematic variables of the performance stages and the racing time of 1,500 m for the research sample?

5. Research Limitations

5.1. Time Limitations

Table 1 Mean, standard deviation, median and torsion constant of the research sample regarding the basic and experimental variables (n = 3)

| Variables | Unit | Research Sample | | Median | Torsion Constant |
|------------------------|------|-----------------|--------------------|--------|------------------|
| | | Mean | Standard Deviation | | |
| Basic variables | | | | | |
| Height | cm | 172 | 3.06 | 173 | -0.94 |
| Weight | kg | 58.3 | 8.14 | 62 | -1.61 |
| Age | m/y | 18.4 | 0.38 | 18.3 | 1.6 |
| Training age | m/y | 4.6 | 1.55 | 4 | 1.73 |
| 1,500 m racing time | S | 4.25 | 0.08 | 4.28 | -1.92 |

This shows the absence of defects in the research sample regarding the distributions of the variables under examination.

6. Research Procedures

6.1. Data Collection Tools and Devices

- Arabic and foreign sources;
- Observation and analysis;
- Computer-based analysis methods (Dartfish);
- Lenovo laptop;
- Filmed copy of players' performance while racing;
- Data form;
- Canon 50 mm;
- Camera height 110 cm;
- Filming area 10m in every clip;
- 8 meters from the internal edge of the track.

6.2. Executive Procedures

6.2.1. Immediate Filming of the Main Experiment

The filming occurred in Al-Yarmouk Stadium at

Sport season 2021-2022.

5.2. Place Limitations

Al-Yarmouk track in the southern governorates in the Gaza Strip.

5.3. Sample Limitations

The Palestinian athletics team players under 20 years in the 1500 m race.

6. Research Procedures

6.1. Methodology

The researchers followed the descriptive approach using the temporal resolution of the 1500 m race.

6.2. Population and Sample

The population included all Palestinian athletics team players under 20 years in the 1500 m race in the Gaza Strip.

Table 1 shows the values of the mean, standard deviation, median, and torsion constant of the basic variables.

6:00 pm. Three Canon cameras were used in the filming: One at the first turn at 500 m, and then at 1,000 m and then at 1,500 m. The camera was installed 8 m from the internal edge of the track and was 110 cm high.

6.2.2. Dividing the Race Stages into Three

The kinematic values and time of every stage were calculated each to facilitate the work of the researchers in the analysis of the skills.

6.2.3. Statistical Treatment

The researchers used the necessary statistical treatments that fit the study: the mean and standard deviation, the highest value, the lowest value, the correlation coefficient, and variance analysis.

7. Discussion

First: To answer the first question, "What are the values of the kinematic variables of the selected performance stages of the 1500 m race for the research sample?"

Table 2 Values of the kinematic variables of the selected performance stages of 1500 m race (N = 3)

| Kinematic Variables | Unit | Mean | Standard Deviation | Lowest value | Highest value |
|--|------|-------|--------------------|--------------|---------------|
| Step length in every stage of performance | cm-m | 1.73 | 0.14 | 1.5 | 2.02 |
| Step frequency in every stage of performance | cm-m | 2.87 | 0.15 | 2.77 | 3.12 |
| Contact time in every stage of performance | S | 0.18 | 0.02 | 16 | 20 |
| Flight time at every stage of performance | S | 0.17 | 0.01 | 16 | 20 |
| Step time in every stage of performance | S | 0.35 | 0.02 | 0.32 | 0.36 |
| Step speed in every stage of performance | S | 4.96 | 0.44 | 4.16 | 5.61 |
| Average speed in all stages of performance | S | 5.09 | 0.4 | 4.34 | 5.74 |
| Height of the center of pressure position in all stages of performance | cm-m | 0.74 | 0.05 | 0.65 | 0.8 |
| Time of the first 500 m | S | 85 | 0.006 | 84 | 85 |
| Time of the second 500 m | S | 93 | 0.00 | 93 | 93 |
| Time of the third 500 m | S | 87 | 0.082 | 78 | 94 |
| Time of interval in all stages of performance | S | 88.68 | 5.56 | 78.53 | 94.36 |

Table 2 shows that the values of the kinematic variables of the stages of performance, which were calculated after the motion analysis of the 1500 m race for the Palestinian athletics team players under 20 years, were as follows: step length, step frequency, contact time, flight time, step time, step speed, average speed, and center of pressure position. The average value of the third time intervals for each stage of performance reached 88.68 seconds, the length 1.73 m, the frequency 2.87 m, the contact time 0.18 seconds, the flight time 0.17 seconds, the step time 0.35 seconds, the step speed 4.96 seconds, average speed 5.09 seconds, and center of pressure position 0.74 cm.

The researchers found that there were differences in the values. They explain the differences due to the changes in the physical and planning levels of the players. Such training includes endurance training, total body resistance training, and controlling race pace training, which are usually ignored among coaches.

The average of the three players' time results shows

that the first 500 m time reached 85 seconds, the second 93 seconds and the third 87 seconds. Based on the above, there appears clear weakness in the ability to handle the race in the second part of the race, which added 8 seconds, and the third, which added 6 seconds.

The researchers believe that the Palestinian team coaches of middle-distance running should rely on the current research results and pay attention to every mentioned variable to improve the results. Coaches may design the training process scientifically and improve the levels of players. Such improvement should be based on scientific methods that help in the motion analysis of the different sports skills.

Second: To answer the second question, "Is there a relationship between the values of the kinematic variables of the performance stages and the racing time of 1,500 m for the research sample?"

The Pearson Coefficient was used to identify the type and strength of the relationship between the variables. The results are as follows:

Table 3 The relationship between the kinematic variables of the selected stages of performance and time of the 1500 m race for the research sample (N = 3)

| Kinematic indicators | First part 500 m | | Second part 500 m | | Third part 500 m | | Total race time 1500 m | |
|-----------------------------|-------------------------|-------|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| | Correlation coefficient | SS | Correlation coefficient | SS | Correlation coefficient | SS | Correlation coefficient | SS |
| Step length | 0.672 | 0.531 | 0.026 | 0.983 | 0.786 | 0.425 | 0.600 | 0.590 |
| Step frequency | -0.520 | 0.652 | 0.701 | 0.506 | -0.961 | 0.177 | -0.936 | 0.230 |
| Contact time | 0.520 | 0.652 | 0.701 | 0.506 | 0.961 | 0.177 | 0.952 | 0.198 |
| Flight time | 0.520 | 0.652 | 0.701 | 0.506 | -0.961 | 0.177 | 0.933 | 0.234 |
| Step time | 0.520 | 0.652 | 0.701 | 0.506 | 0.961 | 0.177 | 0.933 | 0.234 |
| Step speed | -0.385 | 0.749 | 0.030 | 0.981 | 0.486 | 0.677 | 0.118 | 0.924 |
| Average speed | 0.199 | 0.872 | 0.063 | 0.960 | -1.000- | 0.011 | -0.974 | 0.145 |
| Center of pressure position | 0.927 | 0.245 | 0.454 | 0.700 | 0.996 | 0.056 | 0.666 | 0.536 |

Table 3 shows that the correlation coefficient among the kinematic variables (for each stage of the race and the total sum of all stages), and between all parts of the race and the total sum of the race was more than 0.05, which indicates the absence of a statistically significant relationship at $\alpha = 0.05$ between the kinematic variables and the race-time for the Palestinian athletics team players under 20 years.

The researchers believe that several coaches ignore the importance of the biomechanical aspect of

improving sports performance and access to information that provide valid results about the level of players.

New approaches that analyze elite athletes can show more specific information to coaches who place their athletes among the world champions and Olympic medalists [7].

Also, most coaches do not have the required understanding of the motion analysis of the various sports skills [4].

Most coaches do not know the biomechanical rules that influence performance, and so focus only on observation without the use of scientific motion analysis [8].

Based on the aforementioned, coaches should know the connection between every part of the technical stages of any race and the level of performance their players achieve to improve such connection and help the player achieve higher ranks and win, coaches do

not have enough knowledge about the importance of kinematic variables and their relationship with the time spent in every stage a player reaches during the race, which reflects the digital level he achieves.

Third: To answer the third question, "Are there any differences between the values of the kinematic variables of the performance stages and the racing time of 1,500 m for the research sample?"

Table 4 The variance analysis of the differences between the kinematic variables of the selected stages of performance for the 1500 m race for the research sample (F at 0.05 = 3.35)

| N | Variables | Variance Source | Degree of freedom | Square total | Square average | F | Significance |
|---|-----------------------------|-----------------|-------------------|--------------|----------------|--------|--------------|
| 1 | Time | Between groups | 2 | 112.88 | 56.44 | 2.52 | 0.16 |
| | | Within groups | 6 | 134.28 | 22.38 | | |
| | | Total | 8 | 247.16 | | | |
| 2 | Step length | Between groups | 2 | 0.08 | 0.42 | 3.59* | 0.094 |
| | | Within groups | 6 | 0.07 | 0.12 | | |
| | | Total | 8 | 0.15 | | | |
| 3 | Step frequency | Between groups | 2 | 0.087 | 0.043 | 2.58 | 0.155 |
| | | Within groups | 6 | 0.101 | 0.017 | | |
| | | Total | 8 | 0.188 | | | |
| 4 | Contact time | Between groups | 2 | 0.002 | 0.001 | *6.967 | 0.027 |
| | | Within groups | 6 | 0.001 | 0.000 | | |
| | | Total | 8 | 0.004 | | | |
| 5 | Flight time | Between groups | 2 | 0.000 | 0.000 | 0.57 | 0.593 |
| | | Within groups | 6 | 0.001 | 0.000 | | |
| | | Total | 8 | 0.002 | | | |
| 6 | Step time | Between groups | 2 | 0.001 | 0.001 | 2.649 | 0.15 |
| | | Within groups | 6 | 0.001 | 0.000 | | |
| | | Total | 8 | 0.003 | | | |
| 7 | Step speed | Between groups | 2 | 1.048 | 0.524 | 6.543* | 0.031 |
| | | Within groups | 6 | 0.48 | 0.08 | | |
| | | Total | 8 | 1.528 | | | |
| 8 | Average speed | Between groups | 2 | 0.134 | 0.67 | 0.353 | 0.716 |
| | | Within groups | 6 | 1.136 | 0.189 | | |
| | | Total | 8 | 1.27 | | | |
| 9 | Center of pressure position | Between groups | 2 | 0.008 | 0.004 | 1.983 | 0.218 |
| | | Within groups | 6 | 0.12 | 0.002 | | |
| | | Total | 8 | 0.19 | | | |

Table 4 shows statistically significant differences at 0.05 between the three groups regarding the values of the kinematic variables: step length, contact time, and flight time. The value of the significance for the step length variable was 3.59, for the contact time 6.967 and the flight time 6.543; all are more than f value (0.05 = 3.35). There were no statistically significant differences at 0.05 between the three groups regarding the values of the kinematic variables for the remaining variables: the significance for time reached 2.52, frequency 2.58, flight time 0.57, step time 2.649, average speed 0.353, and center of pressure position 1.983.

The visual information coaches depend on observation are not sufficient for collecting data about the real characteristics of the players' motion and required time and mechanics [5].

Therefore, the researchers believe that motion analysis is essential to help determine the stage from which a player starts needing more time, and the step's length and frequency begin to reduce. Doing so may enable the players to overcome this problem.

8. Conclusions

1. The researchers calculated the values of the kinematic variables: step length, step frequency, contact time, flight time, step time, step speed, average speed, and center of pressure position.

2. There are no statistically significant differences at 0.05 between the values of the kinematic variables and the race time of 1500 m race for the Palestinian players' team under 20 years.

3. There are statistically significant differences at 0.05 for some values of kinematic variables: step length, contact time, and flight speed; but the rest of the variables did not show any statistically significant differences.

This study recommends the necessity of the following

6. This study provides the Palestine Athletic Federation with information on athletics about the motion analysis levels of performance.

7. The researchers recommend the use of motion analysis in all athletics fields it provides accurate information about every stage of the race.

8. Modern technologies should be used in the

training of athletics.

9. Temporal resolution should be taken into account for any race because the observation is not enough.

10. The coaches should allocate a part of the training program for every stage of the 1500 m race stages.

11. Coaches should focus on pace control during the race training.

References

- [1] DAKHIH A. Analysis of Some Kinematic Variables of Shooting in Football. *Sports Creativity Journal*, 2022, 13(1): 194-210. <https://doi.org/10.47337/1787-013-001-009>
- [2] PYKE F. *Coaching Excellence*. Human Kinetics, Champaign, 2013.
- [3] ABDULRAHMAN N., & FIKRI S. *Sports Training System*. Dar Al-Fikr Al-Arabi, Cairo, 2014.
- [4] ISMAEL M. Motion Analysis of Back Hand Flip Followed by Straight Air Flip on Balance Bar. *Physical Education Journal*, 2015, 8(4): 89-99. <https://doi.org/10.33984/0904-008-004-007>
- [5] ATWA M. Temporal Resolution of Motion Performance for Long Running Races as Indicator of Skill Training Level. *Journal of Theories and Applications of Physical Education Sport Sciences*, 2020, 33(1): 32-40. <https://doi.org/10.21608/mnase-2019.14832.1005>
- [6] AHSAN A. Influence of Mistakes Correction Program Using Kinematic Analysis on the Motion Performance Learning of Walking: Empirical Study Conducted on the Juniors of Tibarat Association 14-15 years. *Journal of Sport Science Technology and Physical Activities*, 2013. <https://doi.org/10.54031/2070.000.010.007>
- [7] ANTONIETTO N. R., R. P. A. TEIXEIRA, SOTO D. A. S., ANTONIETTO D. Á., AVAKIAN P., REZENDE C. L., AEDOMUÑOZ E., BRITO C. J., and MIARKA B. Effects of Outcomes in Technical-tactical and Time-motion Analysis of Male High-level Taekwondo Bouts. *Journal of Physical Education and Sport*, 2022, 22(6): 1516-1523. <https://doi.org/10.7752/jpes.2022.06191>
- [8] Al-SHAWI Z. Analytical Study of Some Biomechanical Variables for Three Final Steps and Rising and Their Relationship with the Accomplishment Level of the Effectiveness of the Triple-Jump. *Physical Education Sciences Journal*, 2021, 14(2): 398-426. <https://doi.org/10.33984/0904-014-002-024>
- [9] ABDELKARIM H. Kinematic Analysis of Long Back Shot as Base for Development of Some Practices to Be Used in Motion Learning in Squash. *Assiut Journal for Sciences, Arts and Physical Education*, 2018, 46(3): 269-281. <https://doi.org/10.21608/jpr.2018.72378>

参考文献:

- [1] DAKHIH A. 足球射门的一些运动学变量分析。运动创意杂志, 2022, 13(1): 第194-210页. <https://doi.org/10.47337/1787-013-001-009>
- [2] PYKE F. 教练卓越。人体动力学, 香槟, 2013.
- [3] ABDULRAHMAN N., 和 FIKRI S.

运动训练系统。阿拉伯思想馆, 开罗, 2014.

- [4] ISMAEL M. 平衡杆上直空翻后手空翻动作分析。体育杂志, 2015, 8(4): 第89-99页. <https://doi.org/10.33984/0904-008-004-007>
- [5] ATWA M. 长跑比赛运动性能的时间分辨率作为技能训练水平的指标。体育运动科学理论与应用杂志, 2020, 33(1): 第32-40页. <https://doi.org/10.21608/mnase-2019.14832.1005>
- [6] AHSAN A. 使用运动学分析的错误纠正程序对步行运动性能学习的影响: 对提巴拉特协会14-15岁青少年进行的实证研究。体育科学技术与体育活动杂志, 2013. <https://doi.org/10.54031/2070.000.010.007>
- [7] ANTONIETTO N. R., R. P. A. TEIXEIRA, SOTO D. A. S., ANTONIETTO D. Á., AVAKIAN P., REZENDE C. L., AEDOMUÑOZ E., BRITO C. J., 和 MIARKA B. 男子高水平跆拳道比赛技术战术和时间运动分析结果的影响。体育与运动杂志, 2022, 22(6): 第1516-1523页. <https://doi.org/10.7752/jpes.2022.06191>
- [8] Al-SHAWI Z. 最终三步和上升的一些生物力学变量的分析研究及其与三级跳远有效性完成水平的关系。体育科学杂志, 2021, 14(2): 第398-426页. <https://doi.org/10.33984/0904-014-002-024>
- [9] ABDELKARIM H. 长背击球的运动学分析, 作为壁球运动学习中一些实践发展的基础。阿修特科学、艺术和体育杂志, 2018, 46(3): 第269-281页. <https://doi.org/10.21608/jpr.2018.72378>