

## KINEMATIC ANALYSIS OF BELLY DANCE ELEMENTS

Dodi Malada

Faculty of Philosophy, Department of Early and Preschool Education, Split

Original scientific paper

### Abstract

*This study conducted a simple kinematic analysis that can be used to evaluate the quality of dance movements, or specific motor skills in dance structures, in this case, belly dance that has become a popular recreational activity for women. The study was conducted on a sample of two subjects, a female student of the second year of the undergraduate study of kinesiology in Split, who had never been involved in belly dancing, and a female student with prior experience in belly dancing. The sample of variables consisted of 2 elements of belly dance: figure 8 and hip thrusts in the descent to the squat and back. The results of the study led to the conclusion that the educated female subject in this research dominates the motor abilities that are important in aesthetic kinesiological movements such as coordination, flexibility and balance, and that all these abilities significantly affect the performance of the belly dance elements and especially the performance of large amplitudes of movements. In choosing dance recreational activities, an increasing number of women are choosing belly dancing. And not only young girls, but more and more mature women are also included in dance programs of this type, which in the end is the goal of recreational activities, to arouse greater interest of participants in any kind of kinesiological activities and recreation.*

**Key words:** belly dance, analysis, recreation.

### Introduction

Dance is an indispensable teaching tool in kinesiology education for women from elementary school to college, as it contributes significantly to the development and maintenance of basic motor skills. Thus, many teachers use dance as an indispensable kinesiological operator whose transformational values are evident in practice and some research confirms this scientifically (Srhoj and Miletić 2000, Srhoj Lj 2002, Miletić et al. 2004, Srhoj et al. 2006). The study of the kinematics of sports activities is important for the advancement and understanding of the movement and thus the functioning of the human body. Such research requires an interdisciplinary approach, e.g. the involvement of experts and the use of knowledge from various scientific fields. Partial solutions are also possible to deepen the knowledge and possibilities of application based on this knowledge, but this approach, without a broad insight into the problem, certainly has no real perspective or guarantees that the results achieved are not inconsistent with other aspects of the problem being addressed. Based on the results obtained by kinematic analysis, it is possible to program kinesiological treatments in sports games, improve diagnostics and selection process in kinesiological activities, and establish reference anthropometric models of top athletes. By kinematic analysis, we invalidate that subjective part of the perception of something or someone. It allows us to make evaluations that, without kinematically analyzed parameters, are based solely on the estimation of the viewer, participant or expert. With the advancement of information and video technology, analyses of diverse motor activities have become more diverse and detailed. Such analyses broaden our understanding of the structure of workloads in

individual sports, both individual and collective. These insights are important for us to rationally plan and control the training process (Granic, 2010). The field of kinesiological research covers not only sports games and disciplines but also all forms of sports recreation. In choosing recreational dance activities, an increasing number of women are choosing belly dancing. And not just young girls, but more and more mature women are joining dance programs of this type. Oriental dance was created for the female body with an emphasis on abdominal muscles, hip and chest movements. It's solid and grounded. This dance is characterized by smooth, fluid, complex, sensual movements, alternating with shaking, curving movements. The driving force of the dance tempo is characteristic music, extremely emotionally stimulating that inspires the movement.

The basic elements of belly dancing are: passive stretching, rib isolation, upper extremity isolation, palm isolation, hip circle, hip bounce, horizontal figure 8, vertical figure 8, Egyptian shimmy and shoulder shimmy. Belly dance is a predominantly recreational activity in which the choice of elements and the manner of performance must not be rigorously defined in order to simultaneously improve or maintain a satisfactory level of anthropological status and to attain emotional relief. Since no kinematic parameters have been developed so far, the intention of this research is to determine the kinematic parameters of certain elements of belly dance. What the author was particularly interested in was the comparison of kinematic variables in the temporal and spatial component of belly dance elements in a trained and first-time belly dance participant.

The aim of this research is to test and utilize the ability of motion assessment instruments. The main objective of this research is to identify some kinematic parameters that describe belly dance and further compare them with the same movements among subjects, one of whom was engaged in and the other never engaged in belly dance.

## Methods

### Subject sample

The study was conducted on a sample of two subjects, a second year undergraduate student of kinesiology in Split who had never practiced belly dance and a subject with experience in belly dance. Subjects were clinically healthy and free of aberration.

### Sample of variables

The sample of variables consisted of 2 elements of belly dance: figure eight and hips thrusts in descent to the squat and back. It is important to note that the elements are performed in the highest possible amplitude with the maximum frequency of movement for as long as possible.

Figure eight - Basic posture with slightly spaced legs, shoulders forward and strive to maintain this position without rotating the shoulders. Arms outstretched. The center of gravity is lowered slightly. By rotating the right hip to the left, rotation is also performed in the right knee joint while the left leg is in extension. In this position, the right hip moves forward, with no apparent abrupt transitions describing the circular movement to the right, ending backwards as the right foot gradually moves into the extension position. We arrive at the starting position for a roundabout movement on the left hip. Repeat the same movement with the left hip, fluently, without interruption so that in fact the hips form the figure eight without movement and rotation of the shoulders.

Hip thrusts - Dexterous posture, arms outstretched, lower center of gravity, shoulders lowered straight and fixed forward with no movement, raised diaphragm. From this position, with a strong contraction, lift the right hip upwards, towards the ribs, without moving the upper body, thereby thrusting the hips in a diagonal position. With a strong jerk of the right hip upward, seek to "reduce" the space between the hip and ribs. After hitting the right hip, the starting position for hitting the left hip is created.

### Methods of data processing

Video recording was done with a single video camera (Basler 402 fc) at a speed of 100 frames per second. The camera was directly connected to the laptop via a Firewire cable. Appropriate software was installed on the computer, which made it possible to record and digitize a sequence of recorded images to a hard drive (HDD). Both subjects performed two elements of belly dancing, hips circling and hips thrusts.

Reference points are marked on the forehead (M1), two on the shoulders (M2, M3), navel (M4), two on the hips (M5, M6) and two on the knees (M7, M8). The recording was done in the sports hall of the Faculty of Kinesiology in Split.

After the video was recorder, the data were processed in several stages: digitization of the video (the recorded material was converted into a series of standalone images in a digitized format), digitization of reference points (coordinate readings from each image - eight reference points were taken: forehead, shoulders, navel, hips and knees), filtering data (reducing errors made during digitization) and calculating and reading kinematic sizes using Microsoft Office Excel. The standard deviation was also calculated as part of the statistical analysis.

## Results and discussion

For the sake of better transparency and clearer insight, the results were analyzed by individual stages of element performance.

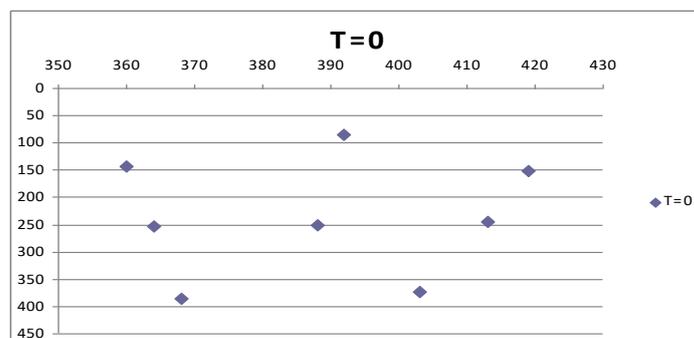


Figure 1. The first moment of peak performance.

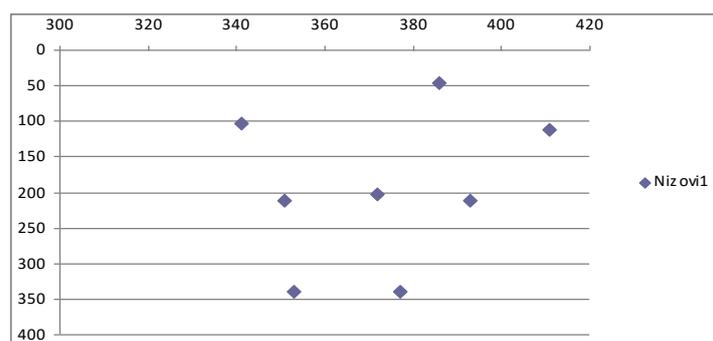


Figure 2. The first moment of the elements' performance of the student.

For good element performance, starting position is very important. Figure 1 and Figure 2 show the starting moment, or the coordinates of the projections in a two-dimensional space at the beginning of the performance.

Thus, already in the preparatory phase of the side-impact element, there are differences between the two performances of these elements. It is observed that at the initial moment the correct position was

reached at the correct position, balanced with respect to the markers since the first moment was performed on the fingers. The symmetry of the markers shown indicates the correct position of the body (Figure 1) which could not be said for the initial position of the second subject (Figure 2) since it is evident that the position is slightly

rotated to the left and it is assumed that the respondent (Graph 2) is in the initial position lacks security in equilibrium position on the fingers. It is probably about finding and taking a secure position for the further performance of the elements, which will certainly affect the further performance of the elements.

Table 1. Comparison by markers M4 and M5, display of comparison of the standard deviation.

	MARKERI	MX4	MY4	MX5	MY5
VRH.IZV.	SD	4,337	42,001	10,796	39,685
STUD.	SD	3,040	38.471	3,497	40,808

According to the previously noted characteristics of the first moment, the most noticeable difference in the performance of the first element of hip thrusts was between markers 4 (navel) and 5 (hip). Since these are elements of high or maximum amplitude of motion and as high frequency as possible over a long period of time, a.k.a., taking an equilibrium position in the execution of elements to the squat and back from the above visible results, the amplitude of motion at peak performance is much higher, which was performance goal, rather than in the student, which is supported by the data in Table 1 where it is evident that the SD values are much higher at peak performance. The hip thrust is an element of maximum amplitude to the side, so the results at peak performance are visible and the table showed much higher values for the subject who performed the element better and more correctly.

The results were probably influenced by better flexibility in the pelvic region and a higher level of acquisition of that motor knowledge, which in turn led to better control of movement and balance. It is also very important to consider the likelihood of an impact of coordination skills that include multiple involvement of individual muscle groups of the

torso and pelvis, or coordination of individual elements in order to perform as best as possible one such fluid complex movement. One of the common motor skills monitored is coordination, which is part of the ability to regulate movement. It is the ability to perform complex motor tasks in a time-, space- and energy-efficient manner (Sekulić and Metikoš 2007).

Coordination correlates significantly with a number of other motor skills, which often limit it as well. Coordination is not determined by a single factor. It consists of a large number of "manifestations" (Sekulić and Metikoš 2007).

It is likely that anthropometric dimensions (hip width) also had a significant impact on the difference in results. From the above results, it can also be concluded that the performance also affected the time continuity of the element, since with the female student as a subject it was significantly shorter, which can also be attributed to the insufficient level of motor task acquisition and therefore the inability to control muscle movement as quickly as possible, but as well as inarticulated and incomplete performance of the elements resulting in a much shorter execution time.

Table 2. Comparison of markers, display of differences of the standard deviation.

	MARKERI	MX4	MY4	MX5	MY5
VRH.IZV.	SD	4,777583	39,65528	5,854665	42,69143
STUD.	SD	4,800957	39,42382	5,284285	40,51999

Also evident are the differences in the performance of the elements of the figure eight, especially in markers 4 and 5 in the same way as in the design of the impact elements, as shown in Table 2.

## Conclusion

From the listed data and analysis, it can be concluded that the causes of differences in the performance of the two elements of belly dance, between peak performance and performance without prior knowledge, are probably based on better flexibility in the pelvic area of the trained subject and a better level of motor knowledge

acquisition, which results in certainly better movement control and also a better balance, which is a basic prerequisite for the proper performance of these elements. Although the anthropometric dimensions were certainly not carried out in the present study, which should be done in the future, in this case the width of the hips has a significant influence on the superior performance of the elements. We can also conclude that the educated subject in this study dominates the motor abilities that are important in aesthetic kinesiological movements such as coordination, flexibility and balance, and that all these abilities significantly affect the performance of the belly dance elements,

and especially the performance of large motion amplitudes. The motor knowledge fund in the field of aesthetic kinesiological movements, which the expert has, positively contributes to the quality of rationality and precision of the performance of the above elements. As in the case of the performance of most of the peak elements of aesthetic movements, proper execution of the initial parts of the element is extremely important for the proper technique of execution, which reflected on the further execution of the element, which created a significant precondition for the successful continuation and safe realization of the execution of the element. In an effort to improve the performance of the above elements, it is first and foremost necessary to develop appropriate and better hip flexibility and to develop a better balance. When learning this element, the greatest attention should be paid to the initial position, that is, to establish a balance, which is an essential prerequisite for further quality performance of both these and other elements of belly dance. In a way, we can say that the performance of the element was also influenced by the development of specific coordination that reflects the ability to perform

different movements in the chosen sport quickly, but also with impeccable ease and accuracy. This coordination segment is closely related to the specificity of motor skills. Specific coordination is achieved as a result of performing numerous repetitions of specialized skills or technical elements during sports training and competition. These results were expected because the students in the program showed the most interest and willing moment for exercises to strengthen the abdominal muscles (Sivrić et al. 2012).

In this study, a simple kinematic analysis was conducted that can be used to evaluate the quality of dance movements, or specific motor skills in dance structures in this case, belly dance, which has become a popular recreational activity for women. In choosing recreational dance activities, an increasing number of women are choosing belly dancing. And not only young girls, but more and more mature women are becoming involved in dance programs of this type, which in the end is the goal of recreational activities, to arouse the greatest interest of participants for any kind of kinesiological activities and recreation.

---

## References

- Čuljak, Z. (2010). *Kinematička analiza dva načina izvedbe premeta unazad*. [Kinematic analysis of two ways of performing a backwards cartwheel. In Croatian.]. Seminar paper. Split: Faculty of Kinesiology.
- Krstičević, T. (2009). *Kinematička efikasnost izvođenja zgrčenog salta u akrobatskom rock'n'rollu*. [Kinematic efficiency of performing a convulsed flip in acrobatic rock'n'roll. In Croatian.]. Dissertation. Zagreb: Faculty of Kinesiology.
- Milner, T. (2007). *Kinematic analysis of bellydance movements*. Toronto: SFU Kinesiology, Neuromuscular Control Lab.
- Miletić, Đ., Katić, R., & Maleš, B. (2004). Some anthropologic factors of performance in rhythmic gymnastics novices. *Coll Antropol*, 28, 727-737.
- Mihaljević D., Lj. Srhoj, & Katić, R. (2007) Motor abilities at belly dance in elementary female scholars. *Coll Antropol*, 31(3), 817-822.
- Srhoj, Lj., & Miletić, Đ. (2000). *Dance structures*. Split: Abel International.
- Srhoj, Lj. (2002). Effect of motor abilities on performing the Hvar folk dance cilion in 11-year-old girls. *Coll Antropol*, 26, 539-543.
- Srhoj, Lj, Katić, R., & Kaliterna, A. (2006). Motor abilities in dance structure performance in female students. *Coll Antropol*, 30(2), 335-341.
- Sekulić, D., & Metikoš, D. (2007.) *Osnove transformacijskih postupaka u kineziologiji - udžbenik*. [Fundamentals of Transformational Procedures in Kinesiology - Textbook. In Croatian.]. 162.
- Sivrić, H., Lopac, T., & Milić, M. (2012). Utjecaj programiranog fitnes treninga u nastavi TZK-a na promjene u pokazateljima repetitivne snage za studentice. Zbornik radova 21. ljetne škole kineziologa RH. [The impact of programmed fitness training in TZK teaching on changes in repetitive strength indicators for female students. Proceedings of the 21st Summer School of Kinesiology of the Republic of Croatia. In Croatian.]. Zagreb: Croatian Kinesiology Association. 523-529.
- 

Received: December 10, 2019

Accepted: December 24, 2019

Correspondence to:

Dodi Malada

Faculty of Philosophy, Department of Early and Preschool Education, Split

E-mail: dodimalada@gmail.com