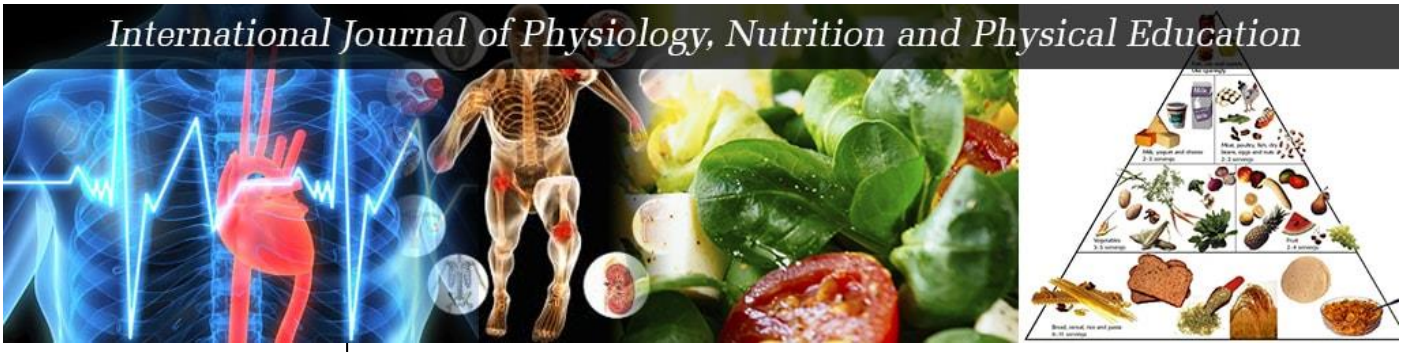

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Effect of step aerobic training for six weeks with 8 inches step platform at 126 beats per minute (BPM) on kinematic (Partial temporal) variables

Dr. Sonia Shalini

Abstract
A study conducted with the objective to test the effect of step aerobic training for six weeks with 8 inches step platform at 126 beats per minute (BPM) on selected kinematic (Partial Temporal) variables. The study was delimited to female subjects only (N=30), age ranging from 18 to 22 years and the intensity of training set to 126 beats per minute as the protocol. The study delimited to selected kinematic (Partial Temporal) variables namely as Leg Step up, Leg Step down, Upward Arm Swing, Downward Arm Swing and Ratio Variables. The Data Recording and quantification for pre-test and post-test were administered by Video Analysis (analysis for partial temporal variables) post-test was conducted immediately after step aerobic training for 6 weeks with eight inches step platform at 126 BMP. Collected data was computed with mean, standard deviation and t-test. The selected variables for the study were Leg Step up Variable-Right (T1), Leg Step Up Variable-Left (T2), Leg Step Down Variable-Right (T3), Leg Step Down Variable-Left (T4), Leg Step up Variable-Left (T5), Leg Step Up Variable-Right (T6), Leg Step Down Variable-Left (T7), Leg Step Down Variable-Right (T8), Upward Arm Swing while performing variable T1-Variable (T9), Downward Arm Swing Variable while performing variable T2 (T10), Upward Arm Swing while performing variable T3-Variable (T11), Downward Arm Swing Variable while performing variable T4 (T12), Upward Arm Swing while performing variable T5-Variable (T13), Downward Arm Swing Variable while performing variable T6 (T14), Upward Arm Swing while performing variable T7-Variable (T15), Downward Arm Swing Variable while performing variable T8 (T16), Ratio Variables (T17-T32). It was concluded that there was significant effect of step aerobic training on the selected kinematic (Partial Temporal) variables namely as T1,T2,T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13,T14,T15,T16, T17, T18, T19, T20, T21, T22, T23, T24, T25, T26, T27, T28, T29, T30, T31 and T32 in both of the protocols. Effect of step aerobic training for six weeks in different protocol were found to be significant for biomechanical adaptation. All the selected kinematic (temporal) variables supported each other as per the existing literature or research and were found suitable for step aerobic training evaluation.

Keywords: Step aerobic training, kinematic, temporal, BPM

Introduction
The evolution of fitness can be attributed to man's struggle for survival and can be traced back to the beginning of mankind. Throughout prehistoric time, man's quest for fitness was driven by a desire to survive through hunting and gathering. Today, though no longer driven by subsistence requirements, fitness remains paramount to health and well-being. One of the greatest accomplishments to be celebrated in the 21st century is the continuous pursuit of fitness. Hence, research in the area of fitness tries to understand and determine the optimum amount of exercise, the duration, appropriate type of exercise and its adaptation and effects on the individual. People engage in physical activities to enhance their health status, lessen disease risk, modify body composition, reduce stress and improve physical fitness. There are numerous exercise devices and modes to choose from that help them achieve these goals but improper use of these exercise devices and modes can lead to injury. Fitness professionals and personal trainers are continually seeking better and injury-free programs to help people attain their physical fitness goals. It is recognized that the term "Physical Fitness" is composed of a variety of characteristics included in the broad categories of cardio respiratory fitness, body composition including regional fat distribution, muscular strength, muscular endurance and

flexibility. In this context, fitness is defined as the ability to perform moderate to vigorous levels of physical activity without undue fatigue and the capability of maintaining this capacity throughout life [1]. It is also recognized that the adaptive response to training is complex and includes peripheral, central, structural and functional factors [2]. Although many such variables and their adaptive responses to training have been documented, the lack of sufficient in depth and comparative data relative to frequency, intensity, and duration of training make them inadequate to be used as models for quantifying benefits.

A recent aerobic dance development is step aerobic training, which involves stepping up and down on a step platform to the rhythm of music and to the directions of an instructor. An understanding of step aerobic training is important in regard to its popularity, its advantages physiologically and biomechanically. Compared to other weight-bearing exercises, it accommodates varying fitness levels in a training session and can be challenging at any fitness level, from a beginner to a conditioned participant.

Research studies documented various factors that could affect the aerobic requirement (energy cost) of step aerobic training. These included body weight, step platform height, stepping rate, stepping pattern and use of hand-held weights. Further, Machado and Abrantes confirmed in their research that the increases in step intensity resulted in corresponding increases in ground reaction force (Machado, Abrantes).

The determination of biomechanical indicators during step aerobic training, was that the effect of increases in step platform height studied by Santos-Rocha, Veloso, Franco, & Correia, 2001, music tempo studied by Santos, Franco, Correira, Veloso, 2000 and increase in ground reaction force, investigated by Farrington and Dyson, 1995; Bezner *et al*., 1996; Maybury & Waterfield, 1997; Terriet and Finch, 1997, documented that increases in step platform height and music tempo appear to increase ground reaction force. According to these studies the height of a step platform reduces the time interval between the initial contact and the moment of achieving the maximum ground reaction force, which in turn leads to increases in mechanical work load and can therefore influence the way in which the type and technique of movement are adapted according to a study by Santos-Rocha *et al.*, 2001.

Objectives of the study

The objectives of the study were to study the effect of step aerobic training with the Protocol of step platform height (8 inches) and music tempo [126 beats per minute (BPM)] with adaptation to the same on selected kinematic (partial temporal) variables.

Selection of the subjects

Adopting random sampling method, depending upon the willingness of the female subjects, 30 subjects were selected for the purpose of the study. The age of the subjects ranged from 18 years to 22 years. The objectives of the study and the procedure of the testing was explained to all the volunteers in advance before the experimentation was conducted. The consent form was obtained from all the participants in the study in advance.

Selection of the variables

Details of kinematic (Partial temporal) variables

Fig 1: Kinematic variable - starting position

Keeping in view the objectives of the study, following kinematic (Partial temporal) categorized variables were selected

Leg step up variables

Variable T1: Variable T1 refers to the time taken (milliseconds) to place the right foot (Basic Right, first foot up) on the step platform.

Variable T2: Variable T2 refers to the time taken (milliseconds) to place the left foot (Basic Right, second foot up) on the step platform from T1 position.

Variable T5: Variable T5 refers to the time taken (milliseconds) to place the left foot (Basic Left, first foot up) on the step platform.

Variable T6: Variable T6 refers to the time taken (milliseconds) to place the right foot (Basic Left, second foot up) on the step platform.

Leg step down variables

Variable T3: Variable T3 refers to the time taken (milliseconds) to place the right foot (Basic Right, first foot down) on the floor, while stepping down from T2 position.

Variable T4: Variable T4 refers to the time taken (milliseconds) to place the left foot (Basic Right, second foot down) on the floor, while stepping down from T3 position.

Variable T7: Variable T7 refers to the time taken (milliseconds) to place the left foot (Basic left, first foot down) on the floor, while stepping down from T6 position.

Variable T8: Variable T8 refers to the time taken (milliseconds) to place the right foot (Basic Right, second foot down) on the floor, while stepping down from T7 position.

Upward arm swing variables

Variable T9: Variable T9 refers to the time taken (milliseconds) to swing arms up in front of the body while performing variable T1.

Variable T11: Variable T11 refers to the time taken (milliseconds) to swing arms up in front of the body while performing variable T3.

Variable T13: Variable T13 refers to the time taken (milliseconds) to swing arms up in front of the body while performing variable T5.

Variable T15: Variable T15 refers to the time taken (milliseconds) to swing arms up in front of the body while performing variable T7.

Downward arm swing variables

Variable T10: Variable T10 refers to the time taken (milliseconds) to swing arms back to the starting position from variable T9, while performing variable T2.

Variable T12: Variable T12 refers to the time taken (milliseconds) to swing arms back to the starting position from variable T11, while performing variable T4.

Variable T14: Variable T14 refers to the time taken (milliseconds) to swing arms back to the starting position from variable T13, while performing variable T6.

Variable T16: Variable T10 refers to the time taken (milliseconds) to swing arms back to the starting position from variable T15, while performing variable T7.

Ratio variables

Variable 17: Variable T17 refers to the ratio of variable T1 and variable T5. [Basic Right (first foot) and Basic Left (first foot) stepping up ratio].

Variable T18: Variable T18 refers to the ratio of variable T2 and variable T6. [Basic Right (second foot) and Basic Left (second foot) stepping up ratio].

Variable T19: Variable T19 refers to the ratio of variable T3 and variable T7. [Basic Right (first foot) and Basic Left (first foot) stepping down ratio].

Variable T20: Variable T20 refers to the ratio of variable T4 and variable T8. [Basic Right (second foot) and Basic Left (second foot) stepping down ratio].

Variable T21: Variable T21 refers to the ratio of variable T9 and variable T13. [Ratio of time taken to swing arms up while performing Basic Right (first foot up) and time taken to swing arms up while performing Basic Left (first foot up)].

Variable T22: Variable T22 refers to the ratio of variable T10 and variable T14. [Ratio of time taken to swing arms up while performing Basic Right (second foot up) and time taken to swing arms up while performing Basic Left (second foot up)].

Variable T23: Variable T23 refers to the ratio of variable T11 and variable T15. [Ratio of time taken to swing arms up while performing Basic Right (first foot down) and time taken to swing arms up while performing Basic Left (first foot down).

Variable T24: Variable T24 refers to the ratio of variable T12 and variable T16. [Ratio of time taken to swing arms up while performing Basic Right (second foot down) and time taken to swing arms up while performing Basic Left (second foot down)].

Variable T25: Variable T25 refers to the ratio of variable T1 and variable T9. [Ratio of the time taken to place Basic Right (first foot up) on the step platform and the time taken to swing arms upward].

Variable T26: Variable T26 refers to the ratio of variable T2 and variable T10. [Ratio of the time taken to place Basic Right (second foot up) on the step platform and the time taken to swing arms downward].

Variable T27: Variable T27 refers to the ratio of variable T3 and variable T11. [Ratio of the time taken to place Basic Right (first foot down) on the floor and the time taken to swing arms up]

Variable T28: Variable T28 refers to the ratio of variable T4 and variable T12. [Ratio of the time taken to place Basic

Right (Second foot down) on the floor to the time taken and swing arms downward

Variable T29: Variable T29 refers to the ratio of variable T5 and variable T13. [Ratio of the time taken to place Basic Left (first foot up) on the step platform and the time taken to swing arms upward].

Variable T30: Variable T30 refers to the ratio of variable T6 and variable T14. [Ratio of the time taken to place Basic Left (second foot up) on the step platform and the time taken to swing arms downward].

Variable T31: Variable T31 refers to the ratio of variable T7 and variable T15. [Ratio of the time taken to place Basic Left (first foot down) on the floor and the time taken to swing arms up].

Variable T32: Variable T32 refers to the ratio of variable T8 and variable T16. [Ratio of the time taken to place Basic Left (second foot down) on the floor and the time taken to swing arms downward].

Administration of the tests and collection of the data

The video recording for the kinematic (partial temporal) variables were also conducted at the Judo hall of I.G.I.P.E.S.S., the Badminton hall of I.G.I.P.E.S.S., Fitness First and at Ozone Fitness Club. The Data Recording and quantification for protest and posttest were administered by Video Analysis (analysis for partial temporal variables). Post-test was conducted immediately after step aerobics training for 6 weeks with eight inches step platform at 126 BMP.

Statistical analysis

The data obtained was analyzed by computing the mean, standard deviation and two tail 't' test by difference method was computed to these paired observations of protocol experiment for the selected kinematic variables. The research hypothesis was tested using the following formula:

$$t = \frac{\Sigma d}{\sqrt{\frac{N\Sigma d^2 - (\Sigma d)^2}{N}}}$$

Where

N = Sample Size

Σd = Sum Total of Difference between Pre-test and Post-test

Σd^2 = Sum Total of Square of Difference between Pre-test and Post-test

$(\Sigma d)^2$ = Whole Square of Sum of Difference between Pre-test and Post-test

The level of significance chosen was 0.05 for testing the hypothesis.

Table 1: Effect of step aerobic training for six weeks with 8 inches step platform at 126 beats per minute (BPM) on kinematic (Partial temporal) variables

S. No.	Variable	Test	Mean	SD	ΣD	ΣD2	(ΣD)2	T
1.	T1	Pre-test	0.13	0.01	0.17	0.00	0.03	2.78*
		Post-test	0.12	0.00				
2.	T2	Pre-test	0.14	0.01	0.41	0.01	0.17	9.95*
		Post-test	0.14	0.01				

3.	T3	Pre-test	0.16	0.00	0.19	0.00	0.04	6.35*
		Post-test	0.16	0.01				
4.	T4	Pre-test	0.12	0.00	0.13	0.00	0.02	4.79*
		Post-test	0.12	0.00				
5.	T5	Pre-test	0.13	0.01	0.20	0.00	0.04	4.63*
		Post-test	0.13	0.00				
6.	T6	Pre-test	0.15	0.02	0.38	0.02	0.14	3.06*
		Post-test	0.15	0.01				
7.	T7	Pre-test	0.16	0.01	0.15	0.00	0.02	2.45*
		Post-test	0.16	0.00				
8.	T8	Pre-test	0.12	0.02	0.48	0.05	0.23	2.36*
		Post-test	0.12	0.00				
9.	T9	Pre-test	0.00	0.00	3.89	0.51	15.13	108.03*
		Post-test	0.13	0.00				
10.	T10	Pre-test	0.00	0.00	4.04	0.54	16.32	147.85*
		Post-test	0.13	0.00				
11.	T11	Pre-test	0.00	0.00	4.72	0.74	22.28	168.29*
		Post-test	0.16	0.00				
12.	T12	Pre-test	0.00	0.00	3.86	0.50	14.90	54.88*
		Post-test	0.13	0.01				
13.	T13	Pre-test	0.00	0.00	3.90	0.51	15.21	159.22*
		Post-test	0.13	0.00				
14.	T14	Pre-test	0.00	0.00	4.36	0.64	19.01	61.99*
		Post-test	0.15	0.01				
15.	T15	Pre-test	0.00	0.00	5.05	0.96	25.50	15.42*
		Post-test	0.15	0.01				
16.	T16	Pre-test	0.00	0.00	4.83	1.13	23.33	8.15*
		Post-test	0.13	0.01				
17.	T17	Pre-test	1.01	0.07	802.54	29880.66	644070.45	8.75*
		Post-test	1.00	0.03				
18.	T18	Pre-test	0.98	0.07	955.52	35570.81	91318.47	13.33*
		Post-test	0.94	0.04				
19.	T19	Pre-test	1.03	0.05	742.57	27636.25	551410.20	7.72*
		Post-test	1.04	0.03				
20.	T20	Pre-test	1.03	0.05	814.64	31770.86	663638.33	8.29*
		Post-test	1.04	0.08				
21.	T21	Pre-test	0.00	0.00	987.99	43266.28	976124.24	9.54*
		Post-test	1.01	0.04				
22.	T22	Pre-test	0.00	0.00	995.74	41048.69	991498.15	11.13*
		Post-test	0.94	0.04				
23.	T23	Pre-test	0.00	0.00	893.87	35182.40	799003.58	9.67*
		Post-test	1.03	0.04				
24.	T24	Pre-test	0.00	0.00	865.34	34539.72	748813.32	8.84*
		Post-test	1.04	0.13				
25.	T25	Pre-test	0.00	0.00	227.42	7330.27	51719.86	8.04*
		Post-test	1.00	0.00				
26.	T26	Pre-test	0.00	0.00	291.94	8550.39	85228.96	3.86*
		Post-test	1.01	0.03				
27.	T27	Pre-test	0.00	0.00	639.74	25974.41	409267.27	5.76*
		Post-test	1.03	0.02				
28.	T28	Pre-test	0.00	0.00	716.29	23509.35	513071.36	8.95*
		Post-test	0.97	0.13				
29.	T29	Pre-test	0.00	0.00	384.97	14942.57	148201.90	3.85*
		Post-test	1.00	0.01				
30.	T30	Pre-test	0.00	0.00	521.53	23548.75	271993.54	4.33*
		Post-test	1.02	0.02				
31.	T31	Pre-test	0.00	0.00	497.73	19135.84	247735.15	4.77*
		Post-test	1.02	0.02				
32.	T32	Pre-test	0.00	0.00	841.10	30079.99	710817.61	10.55*
		Post-test	0.94	0.04				

*Significant at 0.05 level, T1 – T16 = milliseconds, T17 - T32 = numeric, Notes N = 30
Pre-test = Test conducted before starting the experimental protocol.
Post-test = Test conducted after six weeks of training of the experimental protocol.
Protocol = Performing 'Basic Step' on 8 inch high step platform at 126 beats per min.

The analysis of data in Table 1 documented the mean, standard deviation and 't' ratio on 32 variables of. According to the table, the variable T1 has a mean and standard deviation of 0.13 ± 0.01for pre-test and 0.12 ± 0.00 for post-test with significant 't' ratio (t=2.78) at.05 level. The variable T2 has a mean and standard deviation of 0.14 ± 0.01 for pre-test and 0.14 ± 0.01 for post-test with significant 't' ratio (t=9.95) at .05 level. The variable T3 has a mean and standard deviation

of 0.16 ± 0.00 for pre-test and 0.16 ± 0.01 for post-test with significant 't' ratio (t=6.35) at .05 level. The variable T4 has a mean and standard deviation of 0.12 ± 0.00 for pre-test and 0.12 ± 0.00 for post-test with significant 't' ratio (t=4.79) at .05 level. The variable T5 has a mean and standard deviation of 0.13 ± 0.01 for pre-test and 0.13 ± 0.00 for Post-test with significant 't' ratio (t=4.63) at .05 level. The variable T6 has a mean and standard deviation of 0.15 ± 0.02 for pre-test and 0.15 ± 0.01 for post-test with significant 't' ratio (t=3.06) at .05 level. The variable T7 has a mean and standard deviation of 0.16 ± 0.01 for pre-test and 0.16 ± 0.00 for post-test with significant 't' ratio (t=2.45) at .05 level. The variable T8 has a mean and standard deviation of 0.12 ± 0.02 for pre-test and 0.12 ± 0.00 for post-test with significant 't' ratio (t=2.36) at .05 level. The variable T9 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.13 ± 0.00 for post-test with significant 't' ratio (t=108.03) at .05 level. The variable T10 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.13 ± 0.00 for post-test with significant 't' ratio (t=147.85) at .05 level. The variable T11 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.16 ± 0.00 for post-test with significant 't' ratio (t=168.29) at .05 level. The variable T12 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.13 ± 0.01 for post-test with significant 't' ratio (t = 54.88) at .05 level. The variable T13 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.13 ± 0.00 for post-test with significant 't' ratio (t=159.22) at .05 level. The variable T14 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.15 ± 0.01 for post-test with significant 't' ratio (t=61.99) at .05 level. The variable T15 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.15 ± 0.01 for post-test with significant 't' ratio (t=15.42) at .05 level. The variable T16 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.13 ± 0.01 for post-test with significant 't' ratio (t=8.15) at .05 level. The variable T17 has a mean and standard deviation of 1.01 ± 0.07 for pre-test and 1.00 ± 0.03 for post-test with significant 't' ratio (t = 8.75) at .05 level. The variable T18 has a mean and standard deviation 0.98 ± 0.07 for pre-test and 0.94 ± 0.04 for post-test with significant 't' ratio (t=13.33) at .05 level. The variable T19 has a mean and standard deviation of 1.03 ± 0.05 for pre-test and 1.04 ± 0.03 for post-test with significant 't' ratio (t=7.72) at .05 level. The variable T20 has a mean and standard deviation of 1.03 ± 0.05 for pre-test and 1.04 ± 0.08 for post-test with significant 't' ratio (t=8.29) at .05 level. The variable T21 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.01 ± 0.04 for post-test with significant 't' ratio (t=9.54) at .05 level. The variable T22 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.94 ± 0.04 for post-test with significant 't' ratio (t=11.13) at .05 level. The variable T23 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.03 ± 0.04 for post-test with significant 't' ratio (t=9.67) at .05 level. The variable T24 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.04 ± 0.13 for post-test with significant 't' ratio (t=8.84) at.05 level. The variable T25 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.00 ± 0.00 for post-test with significant 't' ratio (t=8.04) .05 level. The variable T26 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.01 ± 0.03 for post-test with significant 't' ratio (t =3.86) at .05 level. The variable T27 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.03 ± 0.02 for post-test with significant 't' ratio (t=5.76) at.05 level. The variable T28 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.97 ± 0.13 for post-test with significant 't' ratio (t=8.95) at .05 level. The variable T29 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.00 ± 0.01 for post-test with significant 't' ratio (t=3.85). The variable T30 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.02 ± 0.02 for post-test with significant 't' ratio (t=4.33) at .05 level. The variable T31 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 1.02 ± 0.02 for post-test with significant 't' ratio (t = 4.77) at .05 level. The variable T32 has a mean and standard deviation of 0.00 ± 0.00 for pre-test and 0.94 ± 0.04 for post-test with significant 't' ratio (t=10.55).

Discussion of the findings

A comparison between the pre-test and post-test scores of selected kinematic (partial temporal) variables projected that:

1. There was decreasing trend was observed following the adaptation.

Conclusions

1. There was significant effect of step aerobics training on the selected kinematic variables.
2. Six weeks of step aerobic training was found to be sufficient length of training (training cycle) for biomechanical adaptation.

References

1. Shalini SS. A Study on the Effect of Step Aerobic Training on Selected Ground Reaction Force Variables of Female: A thesis in Physical Education (Doctoral,s Thesis). University of Delhi, Delhi, India 2010.
2. Shephard RJ. Fitness of a Nation: Lessons from the Canada Fitness Survey. Basel: S Karger 1986.
3. Smith SF, Smith, CM. Personal Health Choices. Boston: Jones and Barlett Publishers, inc 1990.
4. Wilmore JH. Design Issues and Alternatives in Assessing Physical Fitness among Apparently Healthy Adults in a Health Examination Survey of the General Population". In: Assessing Physical Fitness and Activity in General Population Studies, T. F. Drury (Ed.). Washington, DC: U.S. Public Health Service, National Center for Health Statistics 1988, P107-140.
5. Bacon C, Myers T, Karageorghis CI. Effect of Movement-Music Synchrony and Tempo on Exercise Oxygen Consumption. Manuscript Submitted for Publication 2008.
6. Francis P, Carley J, Kolen P. The Effect of Platform Height on Knee Joint Kinematics and Vertical Ground Reaction Forces in Step Training San Diego University Biomechanics Laboratory. Awaiting Publication 2008.
7. Haskell WL, Montoye HJ, Orenstein D. Physical Activity and Exercise to Achieve Health Related Physical Fitness Components. Public Health Reports 1987;100:202-21.
8. Newton SJ, Zebas CJ, Schroeder JM, Crussemeyer JA. Rearfoot Motion of the Basic Step and Backward Lunge at Different Step Heights". American College of Sports Medicine. National Convention. San Francisco, CA 2003.
9. Corbin CB, Pangrazi RP. The Health Benefits of Exercise". Research Digest for Physical Activity and Fitness 1993;1:1.
10. Smith SF, Smith CM. Personal Health Choices. Boston: Jones and Barlett Publishers, inc 1990.
11. Nagle FJ, Balke BE, Naughton JP. Gradational Step Tests for Assessing Work Capacity. Journal of Applied Physiology 1965;20:745-748.
12. Stanforth D, Stanforth PR. Aerobic Requirement of Step aerobics". International Journal of Sports Medicine

1993;14:129-133.
13. Olson MS, Williford HN, Blessing DL, Reathouse RJ. The Cardiovascular and Metabolic Effects of Step aerobics Exercise in Females". Medicine and Science in Sports and Exercise 1991;23:1311-1318.
14. Woodby-Brown S, Berg K, Latin RW. Oxygen Cost of Aerobic Dance Step aerobics at Three Heights". Journal of Strength and Conditioning Research 1993;7:163-167.
15. Wilmore JH. "Design Issues and Alternatives in Assessing Physical Fitness among Apparently Healthy Adults in a Health Examination Survey of the General Population". In: Assessing Physical Fitness and Activity in General Population Studies, T. F. Drury (Ed.). Washington, DC: U.S. Public Health Service, National Center for Health Statistics 1988, P107-140.
16. Astrand PO, Rodahl K. Textbook of Work Physiology, 3rd Ed. New York: McGraw-Hill 1986, P412-485.