THE PHYSIOLOGIC AND ELECTROMYOGRAPHIC RESPONSES TO WALKING IN REGULAR ATHLETIC SHOES VERSUS "FITNESS SHOES"

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INTRODUCTION

There are a number of so-called “fitness shoes” on the market. The most common are MBT (Masai Barefoot Technology), Skechers Shape-Ups, and Reebok EasyTone. The common denominator of all of these shoes is that they have an unstable sole design, which forces the wearer’s body to constantly struggle to find an equilibrium or balance point. The MBT and Skechers have a rounded sole design, whereas the EasyTones have 1 cm rounded pods (like small BOSU balls) built into the forefoot and heel of the shoes.

Manufacturer’s of these shoes claim that the instability helps wearers to burn more calories, tone muscles, improve posture, improve circulation, relieve back and joint pain, and improve overall health (1,2). The “clinical” studies supporting the benefits of these shoes have all been non-peer reviewed and internally funded. A review of these studies finds that they generally had small sample sizes, lacked adequate research control, and had questionable or no statistical analyses.

Several training studies reported reductions in body weight and percent body fat following 6 and 8 week training periods, respectively (1,2). These results seem to be at odds with a study by Hoppeler et al. (3), who found no increase in caloric expenditure when walking on a treadmill or a 400 meter track while wearing MBT shoes. Studies have also reported higher muscle activation in the abdomen, back, gluteus maximus, hamstrings, and calf muscles when wearing fitness shoes (3,5,6). This greater muscle activity purportedly resulted in increased glutei, hamstring, and gastrocnemius strength, and improved low back endurance in subjects who wore these shoes (1,2).

Because there seems to be unsubstantiated claims about the benefits of walking in fitness shoes, the purpose of this study was two fold: First was to evaluate the exercise

responses (heart rate, oxygen consumption, caloric expenditure, and ratings of perceived exertion) to walking in regular athletic shoes compared to fitness shoes. The second was to evaluate muscle activation (via electromyography) when walking in regular athletic shoes compared to fitness shoes. This investigation was conducted as two separate studies using two separate groups of subjects.

Women were used as subjects in both studies, since they are the primary target market for these shoes. The shoes tested in this study were Skechers Shape-ups, Masai Barefoot Technology (MBT), and Reebok's EasyTone Reeinspire. They were compared to a New Balance running shoe. This investigation was approved by the University of Wisconsin-La Crosse Institutional Review Board for the Protection of Human Subjects. Subjects provided written informed consent before any tests were completed.

STUDY 1

Subjects: Subjects were 12 physically active women between 19-24 years of age. Descriptive characteristics of the subjects are presented in Table 1.

Table 1: Descriptive characteristics of the subject population

	Mean ±SD	Range
Age (years)	22.2±1.64	19-24
Height (cm)	168.6±4.52	160-175.2
Weight (kg)	64.1±5.80	56.8-75

Procedures: Subjects completed a total of 12, 5-minute exercise trials. Subjects walked for 5 minutes at 3.0 mph/0% grade while wearing each type of shoe. There was 5 minutes of rest between each shoe condition so that subjects could change shoes. This sequence was repeated at 3.5 mph/0% grade and at 3.5 mph/5.0% grade. Shoe order within each of the workloads was randomized.

Throughout each trial, oxygen consumption was measured continuously with an AEI metabolic analyzer. Heart rate was recorded each minute with a Polar heart rate monitor and ratings of perceived exertion (RPE) were assessed during the final 30 seconds of each 5-minute trial using the 6-20 Borg Scale. Caloric expenditure during each 5-minute walking condition was calculated from the oxygen consumption data.

Statistical Analysis: Repeated measures ANOVA were used to compare the physiological and subjective responses to walking with regular athletic shoes versus walking with the fitness shoes. Alpha was set at $p<.05$ to achieve statistical significance.

Results: The physiological and subjective responses to each of the shoe conditions are presented in Table 2.

Table 2: Exercise responses to walking in New Balance, Skechers, MBT, and EasyTone Shoes

	New Balance	Skechers	MBT	EasyTone
3.0 mph/0% grade				
HR (beats/min)	94±15.0	94±13.9	93±13.2	96±15.0
VO_2 (ml/kg/min)	14.3±1.17	14.1±1.07	14.1±.95	14.3±1.18
Kcal/min	4.6±.50	4.5±.51	4.5±.40	4.6±.52
RPE	8.0±1.41	8.2±1.58	8.4±1.62	7.9±1.44
3.5 mph/0% grade				
HR (beats/min)	98±13.0	99±13.5	100±14.2	99±13.2
VO_2 (ml/kg/min)	15.7±1.13	15.9±1.21	16.2±1.46	15.8±1.20
Kcal/min	5.0±.62	5.1±.60	5.2±.68	5.1±.61
RPE	9.8±1.42	10.0±1.27	9.9±1.56	9.8±1.4
3.5 mph/5.0% grade				
HR (beats/min)	122±20.3	123±19.8	123±17.6	122±19.9
VO_2 (ml/kg/min)	22.8±1.38	22.9±1.56	23.1±1.43	22.9±1.44
Kcal/min	7.3±.97	7.4±1.00	7.5±1.01	7.4±1.01
RPE	11.3±1.55	11.7±1.72	11.8±1.73	11.2±1.64

There was an increase in VO_2 (ml/kg/min), HR (beats/min), kcal/min, and RPE from 3.0 mph/0% grade to 3.5 mph/0% grade and from 3.5 mph/0% grade to 3.5 mph/5.0% grade. These differences were expected since the workloads differed in intensity. There were no significant differences in VO_2 (ml/kg/min), HR (beats/min), kcal/min, or RPE between each of the four shoe conditions within each workload.

STUDY 2

Subjects: Subjects were 12 physically active females between the ages of 21-27 years. Descriptive characteristics of the subjects for this portion of the study are presented in Table 3.

Table 3: Descriptive characteristics of the subject population

	Mean ±SD	Range
Age (years)	23.3±1.49	21-27
Height (cm)	170.1±6.14	160-183
Weight (kg)	66.7±13.1	56.8-102.4

Procedures: Similar to the energy cost portion of the study, each subject completed 12 walking conditions. Each walking bout was 5 minutes in duration. Subjects walked for 5 minutes at 3.0 mph/0% grade, 3.5 mph/0% grade, and 3.5 mph/5% grade while wearing one pair of shoes (i.e., New Balance , Skechers, MBT, and EasyTone). They then changed shoes and repeated this sequence for the other three pairs of shoes. The order of shoes was randomized for each subject. There was a minimum of 5 minutes of rest allotted between each shoe condition so that subjects could change shoes.

Muscle usage in the rectus abdominus, erector spinae, gluteus maximus, rectus femoris, biceps femoris, and gastrocnemius under each condition was measured using Deluca surface electrodes placed on the respective muscle bellies on the right side of the body. Data from these electrodes was amplified and digitally sampled at 1000 Hz. Post processing of the data included use of the root mean square technique with a 10 ms window and 60 Hz notch filter. Maximum voluntary isometric contractions (MVIC) on all muscles were performed

using manual muscle techniques prior to testing. EMG recordings from three representative strides for each condition were represented as a percentage of the EMG obtained during the MVIC condition for that muscle.

Statistical Analysis: Repeated measures ANOVA were used to compare EMG activity between shoes for each muscle at each speed/grade. Alpha was set at $p<.05$ to achieve statistical significance.

Results: Muscle usage in the six muscles examined in the study is presented in Figures 1-6. There was no significant difference in EMG levels in the gastrocnemius, rectus femoris, biceps femoris, gluteus maximus, erector spinae, or rectus abdominus between the four types of shoes. It can be seen that EMG activity was generally higher at the higher workloads (i.e., 3.0/0% grade vs. 3.5 mph/0% grade vs. 3.5 mph/5% grade), as expected.

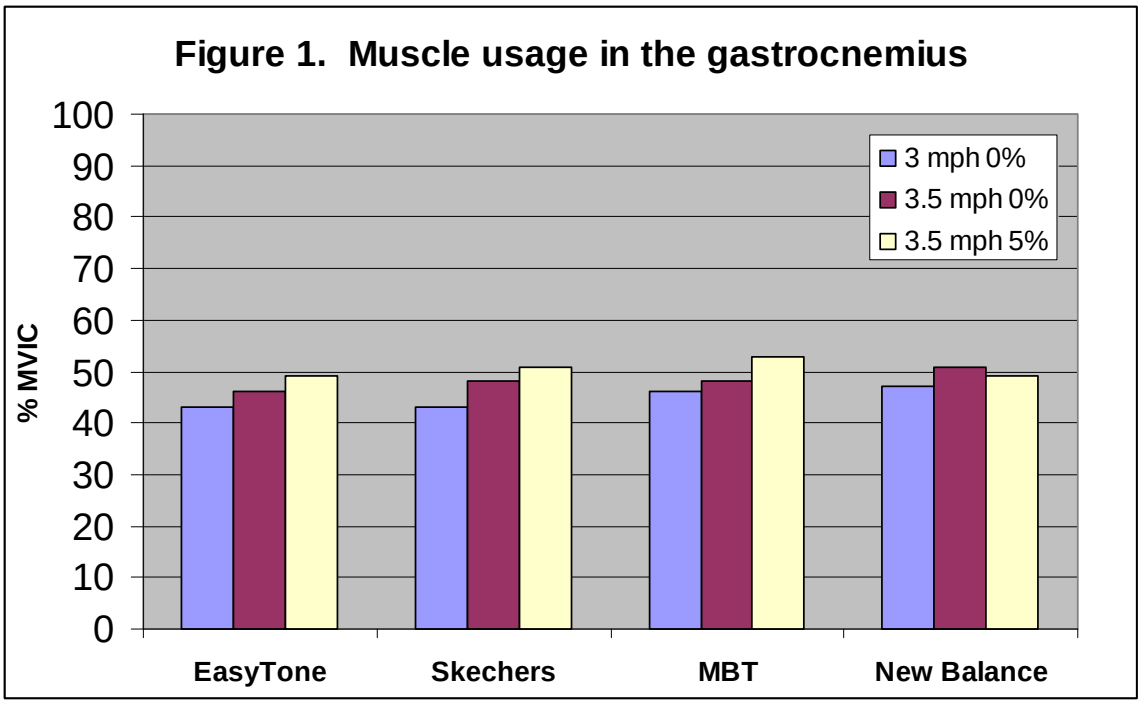
Figure 1. Muscle usage in the gastrocnemius
% MVIC
100
90
80
70
60
50
40
30
20
10
0
3 mph 0%
3.5 mph 0%
3.5 mph 5%
EasyTone
Skechers
MBT
New Balance

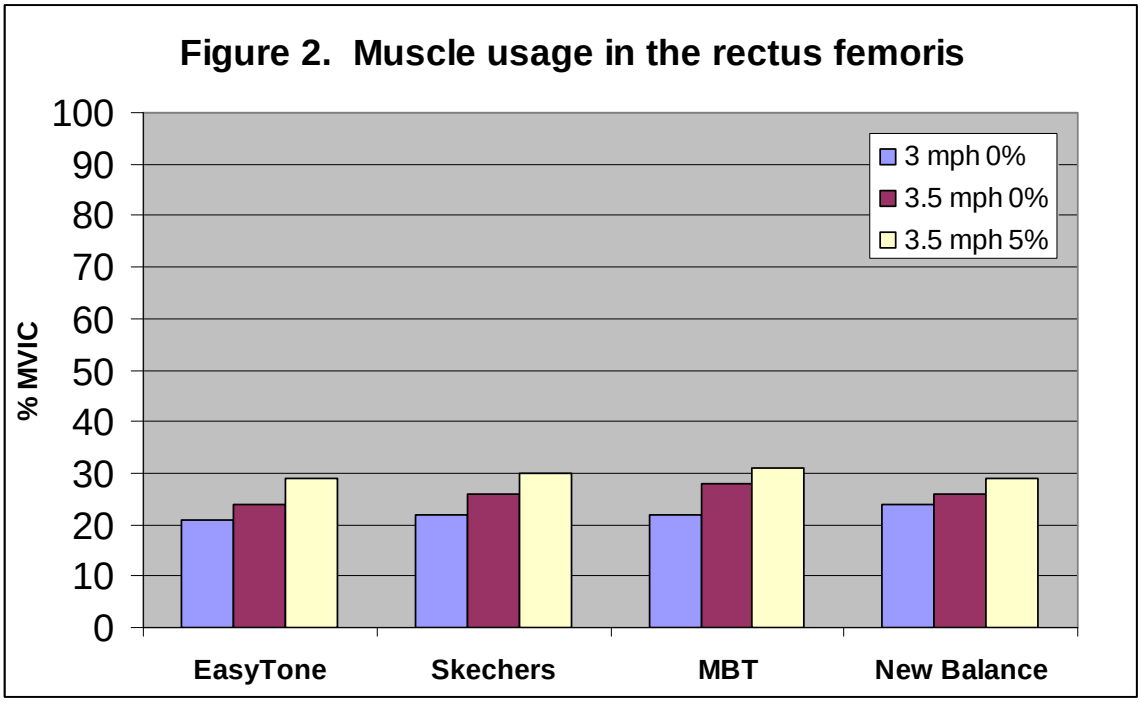
Figure 2. Muscle usage in the rectus femoris
% MVIC
100
90
80
70
60
50
40
30
20
10
0
3 mph 0%
3.5 mph 0%
3.5 mph 5%
EasyTone
Skechers
MBT
New Balance

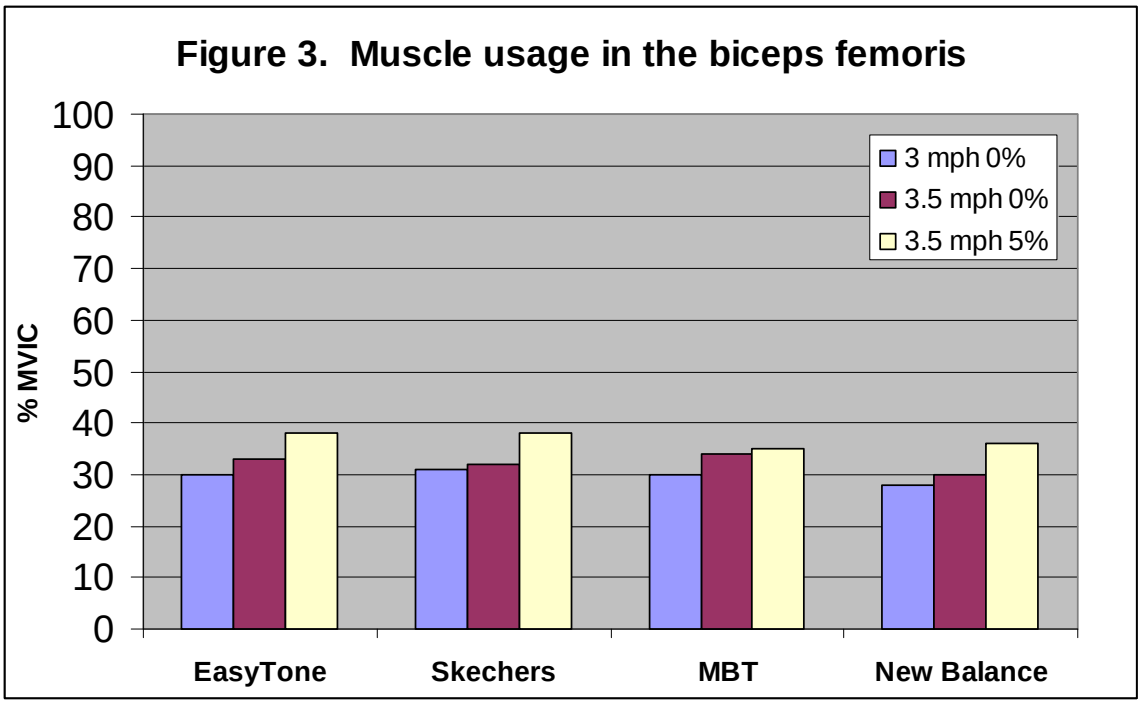
Figure 3. Muscle usage in the biceps femoris
% MVIC
100
90
80
70
60
50
40
30
20
10
0
3 mph 0%
3.5 mph 0%
3.5 mph 5%
EasyTone
Skechers
MBT
New Balance

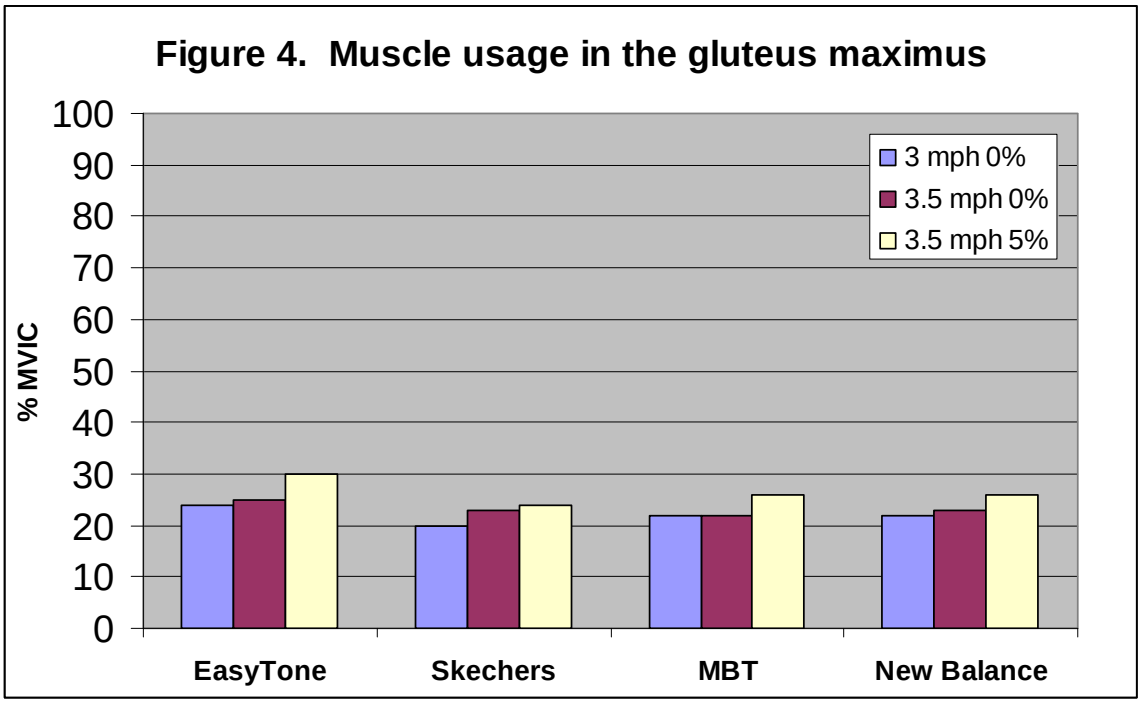
Figure 4. Muscle usage in the gluteus maximus
% MVIC
100
90
80
70
60
50
40
30
20
10
0
3 mph 0%
3.5 mph 0%
3.5 mph 5%
EasyTone
Skechers
MBT
New Balance

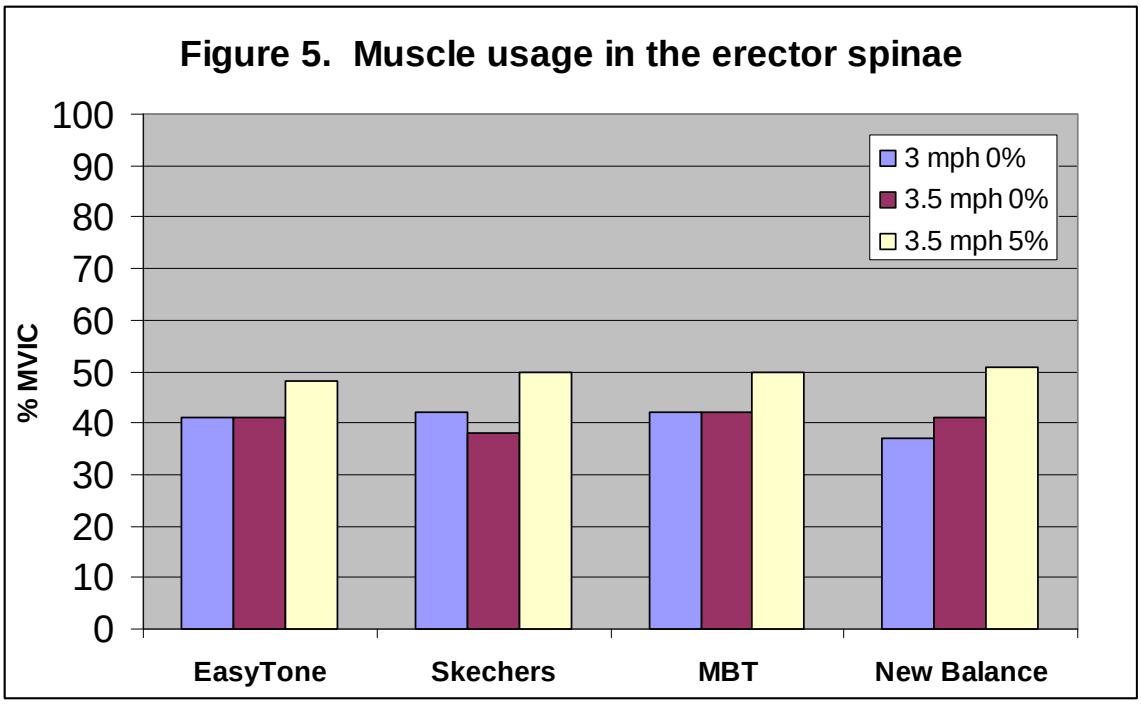
Figure 5. Muscle usage in the erector spinae
% MVIC
100
90
80
70
60
50
40
30
20
10
0
3 mph 0%
3.5 mph 0%
3.5 mph 5%
EasyTone
Skechers
MBT
New Balance

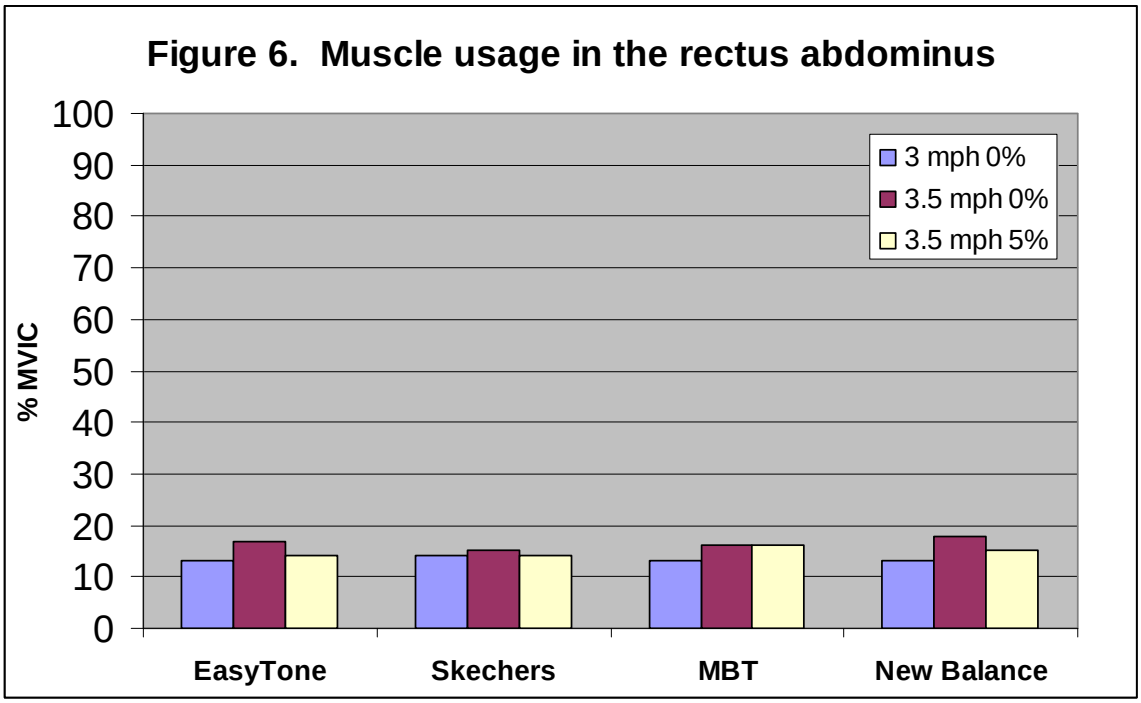
Figure 6. Muscle usage in the rectus abdominus
% MVIC
100
90
80
70
60
50
40
30
20
10
0
3 mph 0%
3.5 mph 0%
3.5 mph 5%
EasyTone
Skechers
MBT
New Balance

Discussion: One of the selling points of wearing shoes with an unstable sole construction is that they supposedly provide a more intense workout than regular walking shoes. The results of this study found no evidence that walking in fitness shoes had any positive effect on exercise heart rate, oxygen consumption, or caloric expenditure compared to walking in a regular running shoe. These results are in disagreement with several training studies which found that training in fitness shoes resulted in significant weight and fat loss (1,2). Subjects who wore Skechers Shape-Ups during 6 or 8 week training periods lost 3.25 lbs (1.125% fat) and 2.78 (1.31% fat), respectively. However, a study by Hoppeler et al. (3) found results similar to the current study. They saw no differences in energy cost or heart rates when subjects walked on a treadmill at speeds ranging from 2.5-4.3 mph at varying grades or when subject walked on an outside track. A curious finding in their study was that oxygen uptake was 9.3% higher when subjects stood in MBT shoes compared to running shoes. However, when subjects stood in MBT shoes and walking shoes of similar weight, there was also no difference in oxygen cost.

In the current study it was felt that there might be a difference in exercise intensity due to the different weight of the fitness shoes compared to the New Balance running shoes. The weight of the shoes (individual shoe) used in the current study was as follows: New Balance – 9.75 oz, EasyTone – 13.375 oz, Skechers – 15.125 oz, and MBT – 16.875 oz. Despite these differences in shoe weight, there were no differences in exercise intensity or caloric expenditure.

Manufacturer's also claim that walking in shoes with an unstable sole construction increases muscle activity in the abdomen, low back, buttocks, and legs when compared to regular walking shoes. Studies on Skechers reported 40-50% higher muscle

activation in the back, thigh, buttocks, and calf muscles during walking in their shoes (5,6). Reebok found that electrical activity in the gluteus muscles was 28% greater for the EasyTone shoes than for a typical Reebok walking shoe which was used as a control (4). Electrical activity was also 11% higher in the hamstring and calf muscles while wearing EasyTone shoes compared to wearing a Reebok walking shoe. In the current study, there were no significant differences in muscle activation levels for any of the muscles tested between any of the shoe conditions. In fact, the biggest differences between any of the conditions for any muscle was only 4% MVIC. As can be seen in Figures 1-6, for some of the conditions the %MVIC values for the reference shoe (i.e., New Balance) were actually higher than any of the fitness shoes.

Conclusion: Companies claim that by wearing fitness shoes, individuals can "get in shape without setting foot in a gym." The results of this study cast doubt upon that claim. Based upon the results of this study, wearing so-called fitness shoes will have no beneficial effect on exercise intensity or caloric expenditure compared to wearing a regular running shoe. Additionally, there is no evidence that wearing shoes with an unstable sole design will improve muscle strength and tone more than wearing a regular running shoe.

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