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THE PHYSIOLOGICAL AND SUBJECTIVE DIFFERENCES BETWEEN WALKING IN FLAT SOLED SHOES VERSUS FITNESS SHOES

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THE PHYSIOLOGICAL AND SUBJECTIVE DIFFERENCES BETWEEN WALKING IN FLAT SOLED SHOES VERSUS FITNESS SHOES

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We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science in Clinical Exercise Physiology.

The candidate has completed the oral defense of the thesis.

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ABSTRACT

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The purpose of this study was to determine if MBT, Skechers Shape-Ups, or Reebok's EasyTone shoes provide walkers with a more intense workout than New Balance walking shoes. Subjects included 12 physically active women ranging from 19 to 24 years of age. Each subject completed 12, 5-minute exercise bouts. The exercise bouts were completed while wearing the four different types of shoes at three different workloads: 3.0 mph/0% grade, 3.5 mph/0% grade, and 3.5 mph/5.0% grade. There was no significant difference in RPE, VO_2, HR, or caloric expenditure between shoe conditions. The results of this study indicate that there is no evidence that fitness shoes provide users with a more intense workout than regular walking shoes.

ACKNOWLEDGEMENTS

I would like to thank Dr. John Porcari for guiding me through this process. I would also like to thank Dr. Richard Pien and Dr. Emmanuel Felix for serving on my thesis committee.

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TABLE OF CONTENTS

INTRODUCTION

Exercise can improve physiologic, metabolic, and psychological parameters as well as decrease the risk of many chronic diseases (2). It is also known that individuals who change from being physically unfit to physically fit experience lower rates of disease and premature mortality compared with those who remain sedentary or unfit (2). A feasible way to initiate routine exercise habits is to begin a walking program. Even if one is already physically fit, walking can be an effective alternative form of aerobic exercise (6). Walking is one of the easiest and most enjoyable forms of exercise (6, 5).

There are new shoes on the market that claim to have additional health benefits in comparison to regular walking shoes. These types of shoes are called "fitness shoes." An example is the Masai Barefoot Technology (MBT) shoe, which features a curved sole that makes the shoe unstable. The company claims that more muscles are used when walking in their shoes. In addition to MBT shoes, Skechers introduced a new shoe called Shape-Ups that purportedly firms muscles and promotes weight loss while walking. Further, Reebok's EasyTone shoes are advertised to tone the buttocks and legs as well as provide a better workout than regular shoes. Shape-Ups and EasyTone shoes are very similar in that they have an unstable construction. Unlike the rocking motion that Shape-Ups have, EasyTone shoes incorporate stability balls into the construction of the shoe and challenge one's balance. The purpose of this study is to determine if MBT shoe, Skechers, or EasyTone shoes provide walkers with a more intense workout than regular walking shoes.

METHODS

Subjects

Women were used as subjects since they are the primary target market for most of The "fitness shoes". Subjects were 12 physically active women between 18-50 years of age. Subjects were recruited from the University of Wisconsin-La Crosse campus.

Procedures

This investigation was first 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. Subjects completed a total of 12, 5-minute exercise trials. Subjects walked for 5 minutes at 3.0 mph/0% grade while wearing the New Balance , Skechers, MBT, and Reebok shoes. Subjects also completed 5 minutes of walking at 3.5 mph/0% grade wearing the four types of shoes, and finally subjects completed 5 minutes of walking at 3.5 mph/5.0% grade while wearing the four types of shoes. Shoe order for each of the three workloads was randomized. There was 5 minutes of rest time allotted between each shoe condition, within each workload, so that subjects could change shoes.

Throughout each trial oxygen consumption was measured continuously with an AEI metabolic analyzer (1). 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

Standard descriptive statistics were used to characterize the subject population. Repeated measures ANOVA was used to compare the physiological and subjective responses to walking with flat soled shoes versus walking with the fitness shoes. Alpha was set at $p<.05$ to achieve statistical significance.

RESULTS

Subjects were 12 physically active women. Descriptive characteristics of the subjects are presented in Table 1. The physiological and subjective response to each of the shoe conditions are presented in Table 2.

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

Table 2: Exercise Responses to Walking in New Balance, Skechers, MBT, and Reebok Walking Shoes

	New Balance	Skechers	MBT	Reebok
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 of each workload.

DISCUSSION

Each of the four shoes differed in aesthetics, construction, and weight. The weight of the four shoes that were used in this study were as follows: New Balance weighed 9.75 oz, Reebok weighed 13.375 oz, Skechers weighed 15.125 oz, and MBT weighed 16.875 oz. However, despite there being differences in shoe weight, there was no significant differences in VO_2, HR, caloric expenditure, or RPE.

Fitness shoes were created based on the idea that walking with an unstable shoe construction provides a more intense workout than regular walking shoes. Hoppeler et al. completed a study and found that standing in a shoe with an unstable construction (MBT) increased oxygen intake by 9.3% when compared to standing in a running shoe (3). Also, Hoppeler had his subjects walk at 4-7km/hour (2.5-4.3mph) at 10% grade and at a decline of 10% and also measured oxygen consumption while wearing MBT shoes and a walking shoe with a similar weight. There was also no difference in oxygen cost (3). Additionally, there is no apparent reason as to why standing in a shoe of different weight would affect oxygen consumption and caloric expenditure. Our findings did not support the results of Hoppeler's study. There was no significant increase in oxygen consumption or caloric expenditure while exercising in any of the fitness shoes compared to regular walking shoes (New Balance). Any changes in caloric expenditure were due to a change in walking speed or treadmill grade.

Manufacturers of fitness shoes also claim that the unstable shoe construction

helps to stabilize ankle joints after an injury. A study by Matthews and Morrissey found that walking in the MBT shoe has the potential to train the muscles surrounding the ankle joint (4). Strengthening injured ankles may be a benefit of the MBT shoe, but it may also hurt healthy ankles. During the current study, some subjects did complain of excessive ankle pronation. This could be because the subject was not used to the fitness shoes or because of inherent problems with this type of shoe from the rounded sole.

Overall, there was no evidence that fitness shoes would provide users with a more intense workout than regular walking shoes. There were no significant differences in VO_2, HR, caloric expenditure, or RPE between any of the fitness shoes or between the fitness shoes and the New Balance walking shoe. Additionally, some individuals may find that the unstable construction may lead to excessive pronation which could lead to ankle or foot problems if the shoes are worn for a prolonged period of time.

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APPENDIX A

INFORMED CONSENT

INFORMED CONSENT

Purpose and Procedure

The purpose of this study is to determine the number of calories burned while wearing four different types of athletic footwear. The footwear to be work for the study will be regular running shoes, Skechers Shape-Ups, Reebok's EasyTone shoes, and MBT shoes. Both Skechers and MBT shoes are similar to regular running shoes, except the sole of the shoe is curved as opposed to straight, which results in a "rocking" type movement pattern. EasyTone shoes have stability balls in the forefoot and heel of the sole of the shoe which challenges one's balance.

My participation will involve one session in the Exercise Physiology Laboratory, located in the Health Science Center. During that session I will be required to complete 12, 5-minute exercise bouts. The exercise bouts will involve wearing the four different types of shoes and will be repeated at 3.0 mph/0% grade, 3.5 mph/0% grade, and 3.5 mph/5.0% grade. Throughout the tests I will be required to wear a scuba-type mouth piece to collect my expired air, as well as a chest strap to monitor my heart rate. Ratings of perceived exertion on Borg's 6-20 scale will be asked of me during the last 30 seconds of each 5-minute stage.

Potential Risks

Because of the curved nature of the sole of the shoe (which results in a "rocking" or unstable walking pattern) I may experience some muscle soreness following the testing session.

The risk of serious complications in very low in a regularly exercising, apparently healthy population. If any emergency should occur, individuals trained in CPR will be in the laboratory at all times. Additionally, the laboratory has a standard emergency plan and an Automated External Defibrillator is readily available.

Rights and Confidentiality

My participation in this study is entirely voluntary and I can withdraw from the study at any time, for any reason, without penalty.

In the event that the results of this study are published in the scientific literatures, my name and personal information will not be identified.

My results will remain confidential. Only the investigator and appropriate laboratory personnel will have access to my individual data.

Possible Benefits

The general public may learn more about the relative benefits of exercising in this new type of footwear.

Questions

Any questions concerning this study may be directed to the primary investigators (John Greany, 608-785-8461 or John Porcari, 608-785-8684). Questions regarding the protection of human subjects may be addressed to the UWL Instutitional Review Board for the Protection of Human Subjects (608-785-8124).

Subject Name (please print)	Signature	Date
Witness Name (please print)	Signature	Date

APPENDIX B

REVIEW OF RELATED LITERATURE

REVIEW OF RELATED LITERATURE

Introduction

Exercise can improve physiologic, metabolic, and psychological parameters as well as decrease the risk of many chronic diseases (1). It is also known that individuals who change from being physically unfit to physically fit experience lower rates of disease and premature mortality compared with those who remain sedentary or unfit (1). A great way to ease into exercising is to begin a walking program. Even if one is already physically fit, walking can be a great form of aerobic exercise (15). Walking is one of the easiest and most enjoyable forms of exercise (15, 14).

There are new shoes on the market that claim to have additional health benefits in comparison to regular walking shoes. These types of shoes are called "fitness shoes." An example is the Masai Barefoot Technology (MBT) shoe, which has a curved sole, making the shoe unstable. The company claims that more muscles are used when walking in their shoes. In addition to MBT shoes, Skechers has a new shoe called Shape-Ups that purportedly firm muscles and promote weight loss just while walking. In addition to Skechers, Reebok's EasyTone shoes are advertised to tone the buttocks and legs as well as provide a better workout than regular shoes. Both shoes are very similar in that they have an unstable construction. Unlike the rocking motion that Shape-Ups have, EasyTone shoes incorporate stability balls into the construction of the shoe and challenge one's balance.

Energy Cost

A study done by Hoppeler et al. found that standing in a shoe with unstable construction (MBT) was found to increase oxygen intake by 9.3% when compared to standing in a running shoe (5). During the same study, however, there was no significant increase in oxygen consumption and heart rate between walking in an MBT shoe and a control shoe of equal weight (5). Lejeune et al. found that walking on sand required 2.1–2.7 times more energy expenditure than walking on a hard surface at the same speed (8). The increase in energy cost is due primarily to two effects: the mechanical work of walking in the sand and a decrease in the efficiency of positive work done by the muscles and tendons (8). Similarly, walking in sand was reported to increase calorie expenditure by 20 to 50 percent more than walking at the same pace on a hard surface (2).

Hip and Back Benefits

Shoes with unstable shoe construction are said to have important therapeutic benefits. A study by Kraus et al. found that wearing MBT shoes decreased pain after a hip replacement and the pain associated with hip joint osteoarthritis (7). Pain while walking, pain while ascending stairs, and total pain development were all found to decrease while wearing MBT shoes (7). Similar results were found in a study done by Nigg (11). Wearing MBT shoes was found to reduce joint loading, therefore reducing joint pain (11). In addition to decreasing hip pain, MBT shoes were also found to increase the quality of life in patients with chronic back pain. In a study by Stegen, it was found that walking in MBT shoes decreased pain in the lower back, as reported by subjective SF-36 results (3). Finally, in a study done by Naik et al., it was found that MBT shoes promote less forward lean during locomotion, which means a shift in the

center of mass while walking. This, along with lower hip moments, may result in reduced loading of the lower back (10).

Ankle Benefits

In addition to providing therapeutic benefits for joint replacement and back pain, unstable footwear also provides therapeutic benefits for ankle injuries. According to previous studies, walking in the MBT shoe has the potential to train the muscles surrounding the ankle joint. In a study by Kalin et al., it was found that the use of MBT shoes over a period of 3 months resulted in a functionally superior stabilization of the ankle joints compared to conventional therapy (6). Similarly, in a study completed by Matthews and Morrissey, subjective ratings of ankle function post-injury improved after wearing MBT shoes for 1 hour, three times a week (9). The authors concluded that recovery following acute ankle sprain may be improved by using an unstable MBT shoe, but further research was suggested (9).

Muscle Usage

Another shoe with an unstable construction is Skechers Shape-Up shoes. The company claims that they have completed three clinical studies in the United States and Japan and have concluded that Shape-Ups significantly increase muscle activity and energy consumption compared to standard fitness shoes (3). Since Shape-Ups have an unstable center of balance compared to normal sport shoes, the body will instinctively try to find the center of balance when wearing these shoes. As a result, it has been found that there is more muscle activity in the muscles of the back, legs, and feet when compared to common sport shoes (16). The specific findings of one study was that muscles in the legs are used more with Shape-Ups than with standard walking shoes (17). Skechers found

that there was approximately 50% more activation in the back muscles while wearing Shape Ups compared to walking shoes and 40% more muscle activation in the thighs, buttocks, and calf muscles while wearing Shape-Ups (16).

Another shoe that provides unstable shoe construction is Reebok's EasyTone shoe. Reebok commissioned a study at the University of Delaware. Five women walked on a treadmill while muscle usage in their legs was monitored with EMG electrodes. 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 (12). Electrical activity was 11% greater in the hamstring and calf muscles while wearing the EasyTone compared to wearing a Reebok walking shoe (12). The test involved only 500 steps and Reebok acknowledges that the effect may diminish as wearers get used to the shoes (12).

Fitness Benefits

Skechers advertises their product as one that improves posture, improves blood circulation, strengthens the back, tightens abdominal muscles, firms buttocks muscles, and also firms calf muscles. The only clinical study completed on Shape-Ups that tested these claims was a small independent study that was commissioned by Skechers. In this study, 80 men and women completed a prescribed 8-week walking program which compared subjects wearing Shape-Ups with those wearing normal athletic shoes (4). Wearing Shape-Ups was found to increase weight loss by 2.78 pounds, decrease body fat by 1.31%, improve gluteal, hamstring, and gastrocnemius strength by 114%, and improve lower back strength by 23% compared to "normal" athletic shoes (4).

Summary

There are currently several brands of "fitness shoes" on the market. These shoes are very similar in that they have an unstable construction. Some of these shoes have a rounded sole which provides users with a rocking motion while walking. Others such as Reebok's EasyTone incorporate balance balls into the heel and forefoot of the shoe which challenges the balance of users. Manufacturers of these fitness shoes report that these shoes provide a more intense workout than regular walking shoes, as well as tone the buttocks, hamstrings, and calf muscles.

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