

EFFECTIVENESS OF TREADMILL AND OUTDOOR WALKING TO REHABILITATION OF CALF TEARS INJURY

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لإعادة تأهيل إصابات الجرح فعالية من تريادميل والوقوف في الهواء الطلق

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Abstract

To evaluate exercise capacity, velocity of gait and cardio respiratory status in recreational athletes who injuries rehabilitation of calf tears injury had received two different walking exercises. Design: Randomized control trial. Subjects: Sixty seven male and female recreational athletes participated in the study and three dropped out. Interventions: Treadmill training and outdoor walking for three weeks. Outcome measures: Six minute walk test, ten meter walk test, pulse rate and blood pressure. Results: Participant compliances with their respective programs were 100%. There was significant difference in the mean increase of score of participants who performed out door walking and treadmill walking in 6 minute walk test ($t=10.103$, $p< 0.0001$ with 62df) and 10 meter walk test ($t= 7.371$, $p <0.0001$ with 62df). Further, there was no significant difference in pulse rate ($t=0$, $p >0.9999$ with 62df) and systolic blood pressure ($t=1.890$, $p=0$ with 62df), and diastolic blood pressure ($t=0$, $p =0.9999$ with 62df). Conclusion: Treadmill can be used as an effective option for improving exercise capacity and velocity of gait in rehabilitation of calf tears injury

Key words: physical activity, exercise capacity, gait velocity, treadmill and outdoor walking.

المستخلص

عنوان البحث (تأثير المشي على الحصييره المتحركه والمشي الحر لتاهيل اصابة سمانة الساق) اعطيت تمارين لكلا المجموعتين الضابطه والتجريبية لمدة ثلاثة اسابيع وبواقع خمس وحدات تاهيلية اسبوعيا على العينه العشوائية وبواقع اربعة وستون مصاب من كلا الجنسين من الذين يمارسون الرياضة الترويحيه تم استخلاص النتائج من الاختبارات القليه والبعديه وهي اختبار المشي ستة دقائق، اختبار عشرة امتار، قياس ضغط الدم، والنبض. كانت النتائج معنويه لكلا المجموعتين والتحسين لصالح الحصييره المتحركه وهذا يدل على ان الحصييره المتحركه يمكن ان تكون الاكثر فائده في علاج اصابة سمانة الساق.

Introduction

Physical exercises have been traditionally performed by humans since the recorded history. Exercise has been known since antiquity. Marcus Cicero, around 65 BC, stated: "It is exercise alone that supports the spirits and keeps the mind in vigor."⁽¹⁾ However, the link between physical health and exercise was only discovered in 1949 and reported in 1953 by a team led by Jerry Morris.^{(2),(3)} Now days, physical exercises are performed all over the world for various reasons like strengthening muscles and the cardiovascular system, toning athletic skills, weight loss or maintenance, as well as for the purpose of enjoyment , and helps prevent the diseases of affluence such as heart disease, cardiovascular disease, type 2

diabetes and obesity.^{(4),(5)} It also improves mental health which is also found to be linked with higher levels of self-esteem.⁽⁶⁾ The word walk is descended from the Old English weal can. Which means to roll? Walking is defined by an inverted pendulum gait in which the body vaults over the stiff limb or limbs with each step). Specific studies have found pedestrian walking speeds ranging from 4.51 km/h to 4.75 km/h for older individuals to 5.32 km/h to 5.43 km/h for younger individuals. ^{(7),(8)}Worldwide there has been a large shift towards less physically demanding work.⁽⁹⁾ This has been accompanied by increasing use of mechanized transportation, a greater prevalence of labor saving technology and less active recreational pursuits. Hence, out of 1,440 minutes in every

day, scheduling 30 of them for physical activity has become a critical part of staying healthy for everyone including recreational athletes⁽¹⁰⁾ Treadmills that were historically also known as tread wheels, were used as a method of reforming offenders in prison, an innovation introduced by Sir William Cubitt in 1817⁽¹¹⁾ The first medical treadmill designed to diagnose heart and lung disease was invented by Dr. Robert Bruce and Wayne Quinton at the University of Washington in 1952. Calf pain in runners is quite common and can become a persistent nuisance. Fortunately it usually responds well to treatment and there are a lot of simple exercises you can do to help it recover¹²

Delimitations:

Following delimitations were considered for this study is recreational athletes with group between 30 to 60 years without any mental psychological social problem and recognize regular and Baghdad-(AL-Rasafa side)the place of the study .

Limitations of the study: Some of the limitations that will not be addressed or taken into consideration in the present study include that Investigator cannot

control of subject activity own their physical work or daily life habits and style so participant medicine intake the investigator couldn't control

Assumptions:

The following assumptions were made for the purposes of this study;

1. Participants want to participate in physical activities like outdoor walking and walking on treadmill to get desire benefit
2. Participants will follow the exact exercise program as per investigator's instructions..
3. Six minute walk test is a good outcome measure to find out exercise capacity in terms of the distance walked.
4. The ten meter walk test is a good outcome measure to find out the velocity of gait.
5. Radial pulse at wrist level is a good measure to find out cardio respiratory status.
6. Blood pressure measured at arm is a good tool to assess cardio respiratory status.

Objectives of the research:

Various objectives of the present study were as follows;

1. To study the effectiveness of outdoor walking in rehabilitation of calf tears.

2. To study the effectiveness of treadmill walking in rehabilitation of calf tears.
3. To compare the effectiveness of outdoor walking and treadmill walking in rehabilitation of calf tears .
4. To study the body of knowledge pertains to outdoor walking and treadmill walking.

Hypothesis: Hypotheses pertaining to study were as follows;

Null hypothesis: There will be change in the participants who were involved in outdoor walking and treadmill walking.

Alternate hypothesis: There will be no change in the participants who were involved in outdoor walking and treadmill walking.

Research question: Can there be any difference in rehabilitation of calf tears as participants after outdoor or treadmill walking for 30 minutes, five times a week for three weeks on 6 minute walk test, ten meter walk test and cardio respiratory parameters like pulse rate and blood pressure.

Significance of the study: Huge number of people including recreational athletes all over the world participates in either outdoor walking or treadmill

walking. The results of this study will help to determine the effectiveness of outdoor and treadmill walking in rehabilitation of calf tears in terms of exercise capacity, velocity of gait and cardio respiratory fitness and hence the results may be useful for exercise assessment, exercise prescription, Rehabilitation injuries and thus indirectly the cost effectiveness of these two form of exercises.

Materlals&Methods

Source of the data: The source of data was Dr. Jasim Al-Azawe clinic (sport Hall Test) AL- Baoee Biliding-New Baghdad –Baghdad- Iraq.

Method of data collection: Method of data collection was primary. The investigator collected the demographic data and outcome measures like six minute walk test, ten meter walk test and cardio respiratory parameters.

Study design: The study design was randomized control trial performed during 5th January 2013 to June 2013 at Dr. Jasim Al-Azawe clinic (sport Hall Test) AL- Baoee Biliding-New Baghdad –Baghdad- Iraq.

Sample: It consisted of recreational athletes in the premises Sports Halls Baghdad-A-Rosafa side-Baghdad- Iraq.

Sample size: The sample size was 67. It was calculated by taking 80 % of average number of recreational athletes often seen at this ground as per the record available with ground maintenance staff.

Sample selection and recruitment: It was decided to recruit 67 participants for this study. Subjects for this study were invited to take part by various means that included putting banners, flyers and

handouts to recreational athletes seen at Sports Halls Baghdad Iraq . The subjects were invited to take part in this study. A total of 103 subjects were screened; out of which 64 subjects were randomly selected for this study. Everyone was given a number during data collection (rather than using their names) so as to preserve his or her anonymity. Subjects right ensured by giving interested people an information sheet about the study, so they can decide whether to take part. If they agreed to become a subject then they were asked to sign a consent form immediately prior to data collection.

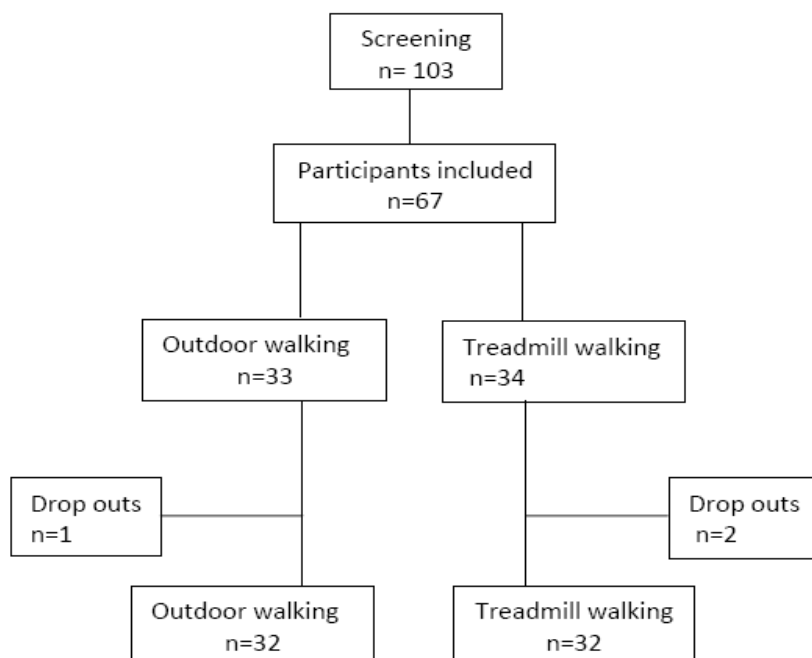


Figure 3.1: Flow diagram of the study

Subjects details: The subjects who participated in this research study comprised of following;

1. Normal healthy male and female subjects.
2. Recreational athletes who were involved in various contact and non-contact sports for recreation.
3. Age group 30 to 60 years.

Subject selection: Potential subjects were provided a written and verbal account of the experimental procedures in accordance with the requirements of Indian council of Medical research (ICMR). Those who agreed to participate then signed a consent form.

Inclusion criteria: Inclusion criteria used for this study were normal healthy individuals, age group 30 to 60 years, recreational athletes, regular involvement in physical activities and recreational sports.

Exclusion criteria: Exclusion criteria were major illness, gross biomechanical abnormality, leg pain, and impaired sensation, physical, mental or psychological, social and psychosocial barriers that would prevent an individual

from walking outdoor or treadmill walking.

Outcome measures: Outcome measures used in this study included the six minute walk test, 10 meter walk test, pulse and blood pressure. The six minute test was performed to find out exercise capacity in terms of the distance walked. The ten meter walk test was performed to find out the velocity of gait and pulse and blood pressure was measured to find out cardio respiratory status.

Independent Variable: Treadmill and outdoor walking physical activity.

Dependent variable: Six minute walk test, ten meter walk test and cardio respiratory parameters like pulse and blood pressure.

Equipment's: Various equipment's used for this research study included weighing machine, measuring tape, stop watch, cones, digital sphygmomanometer (blood pressure recording device) and motorized treadmill. Weighing machine was used to record the body weight of the subject, measuring tape was used to measure the

height of the subject and six minute walk distance and to mark ten meter for ten meter walk test. Citizen digital automatic battery operated blood pressure apparatus CH-403 (figure 1) manufactured by Citizen, India that can measure with pressure: 0 to 280mmHg, pulse: 40 to 200beat/min with an accuracy of pressure ± 3 mmHg and pulse: $\pm 5\%$ was used for recording blood pressure and pulse rate. Treadmill TM-150 (figure 2) manufactured by Perfect Fitness, China with belt speed ranging from 0 to 16 km, 2 HP AC motor and user capacity of 150 Kg was used for treadmill exercise.

Material details: Data collection sheets, consent forms etc.

Subject preparation: Subject wore loose clothes, track suits or shorts and sports shoes as per their convenience as to expose the examined lower limbs.

Procedure: Prior to the intervention, baseline data about body weight, height, body mass index and outcome measures like resting pulse, blood pressure, six minute walk test and ten meter walk test was assessed. For the six minute walk test the participants were asked to walk as fast as they could for 6 minutes. They

were told that they would be informed of the length of time at 2, 4 and 5 minutes of the six minute walk test. Distance walked in meter were measured by the investigator. The test was performed in a 100 feet walkway. Pulse and blood pressure was recorded at rest and after the six minute walk test. After a break of ten minutes, 10 meter walk test was performed. A 10 meter walk test was performed by walking 10 meter, on 14 meter long walk way, with 2 meter for warming up and 2 meter for slowing down, as also used in other studies.¹³

The participants were instructed to walk as fast and as safely as they could. The velocity of gait (meter/seconds) was calculated by dividing the walking distance of 10 meters by elapsed time and then multiplying by 60. Pulse and blood pressure was recorded at rest and after the six minute walk test and after the ten minute walk test. Then, all the participants were randomly allocated to outdoor walking or treadmill group. The participants in treadmill group did walking exercises on treadmill for 30 minutes five days a week in the evening for three weeks. The treadmill had hand railings to hold on and the exercises were carried out with the treadmill in a

flat position. The speed was started on the lowest level and was increased within the first minutes to the working level. The working load was increased with cooperation of the participants to a level they felt comfortable with and they felt no insecurity in balance, fall or any sort of discomfort. The participants in outdoor walking group also performed walking on the sports hall in the evening time for five days a week at a

comfortable speed in the evening for thirty minutes regardless of weather conditions for three weeks. The length of the walk was dependent on time rather than distance, and the intention was a 30 minute continuous walk. Participants in both the groups were permitted to take short break of five minutes if required. After three weeks of interventions, outcome measures were assessed.



Figure 3.2: Digital blood pressure



Figure: 3.3: Motorized treadmill

Results

Subject demographics: A total of 103 participants were screened with a questionnaire to determine if the inclusion criteria were met. After the exclusion only 67 participants were accepted into this study after initial screening, but only 64 participants

completed the study. Three dropped out because of their inability to take out time on regular basis from schedule or personal reasons. Out of the subjects who completed the study, 40 were male and 24 were female subjects. The average age of these participants was 33.94 ± 2.565 years, body height 160.93 ± 6.243 cms, body weight 58.88 ± 6.407

kg and BMI $25.12 \pm 1.55 \text{ kg/m}^2$. There were no baseline differences between the groups.

Table No. 4.1: Characteristics of the participants

Sex	Sample size	Mean age (yrs.)	BMI (kg/cm^2)
Male	40	34.17 ± 2.552	25.20 ± 0.40
Female	24	33.66 ± 2.578	25.04 ± 2.65

Six minute walk test: The baseline six minute walk test score of subjects who participated in outdoor walking was 631 ± 158 meter and after three weeks of outdoor walking intervention this score was 649 ± 164.4 . On the other hand, the baseline six minute walk test score of participants who participated in treadmill

was 638 ± 169.9 meter and after three weeks of walking on treadmill intervention this score was 705 ± 157.9 meter. There was significant difference in the mean increase of six minute walk test score of participants who performed out door walking ($t=10.103$, $p < 0.0001$ with 62df).

Table No.4.2: Six minute walk test score (meter)

Study group	Pre intervention	Post intervention	Difference	P value
Outdoor walking	631 ± 158	649 ± 164.4	18 ± 4.3	0.0001
Treadmill	638 ± 169.9	705 ± 157.9	67 ± 7.9	

Ten meter walk test: The baseline ten meter walk test score of participants who participated in outdoor walking was 0.8 ± 0.4 meter/second and after three

weeks of outdoor walking intervention, this score was 0.9 ± 0.3 meter/seconds. On the other hand, the baseline ten meter walk test score of participants who

participated in treadmill was 0.9 ± 0.2 meter/second and after three weeks of walking on treadmill intervention, this score was 1.3 ± 0.4 meter/seconds. There was significant difference in the mean

increase of ten meter walk test score of participants ($t = 3.681, p = 0.0005$ with 62df).

Table No.4.3: Ten meter walk test score

Study group	Pre intervention	Post intervention	Difference	P value
Outdoor walking	0.8 ± 0.4	0.9 ± 0.3	0.1 ± 0.35	0.0005
Treadmill	0.9 ± 0.2	1.3 ± 0.4	0.4 ± 0.3	

Cardio respiratory parameters: The baseline cardio respiratory parameters of participants who participated in outdoor walking were; pulse rate 72 ± 2.5 and blood pressure $120 \pm 6.5/80 \pm 2.1$. After three weeks of outdoor walking intervention, these parameters were pulse rate 74 ± 2.1 and blood pressure $123 \pm 5.2/82 \pm 3.1$. On the other hand, the baseline parameters of participants who participated in treadmill were; pulse rate

72 ± 3.1 and blood pressure $120 \pm 5.1/80 \pm 2.8$ and after three weeks of walking on treadmill intervention, these parameters were pulse rate 70 ± 4.1 and blood pressure $118 \pm 8.5/82 \pm 3.9$. There was no significant difference in pulse rate ($t = 0, p > 0.9999$ with df 62), and systolic blood pressure ($t = 1.526, p = 0.1320$ with df 62), and diastolic blood pressure ($t = 0, p = 0.9999$ with df 62).

Table No 4.4: Mean nulse rate

Study group	Pre intervention	Post intervention	Difference	P value
Outdoor walking	72 ± 2.5	74 ± 2.1	2 ± 2.23	0.9999
Treadmill	72 ± 3.1	70 ± 4.1	2 ± 2.96	

Table No.4.5: Mean blood pressure (mm of Hg)

Study group	Pre intervention	Post intervention	Difference	P value
Outdoor walking	120±6.5/80± 2.1.	123±5.2/82± 3.1.	3 ± 2.23/2±2.62	0.1320/0.999
Treadmill	120±5.1/80± 2.8	118±8.5/82± 3.9	2± 2.96/2±2.49	

Table No.4.6: Mean difference in outcome measures after interventions

Outcome measure	Outdoor walking N=32	Treadmill walking N= 32	P value
Pulse (beats/min)	2±2.23	2±2.96	0.9999
Blood pressure (mm of Hg)	3±2.23 /2±2.62	2±2.96 /2±4.9	0.1320/ 0.9999
6-MWT(m)	18±4.3	67±7.9	0.0001
10-MWT(m/s)	0.1±0.35	0.4±0.3	0.0001

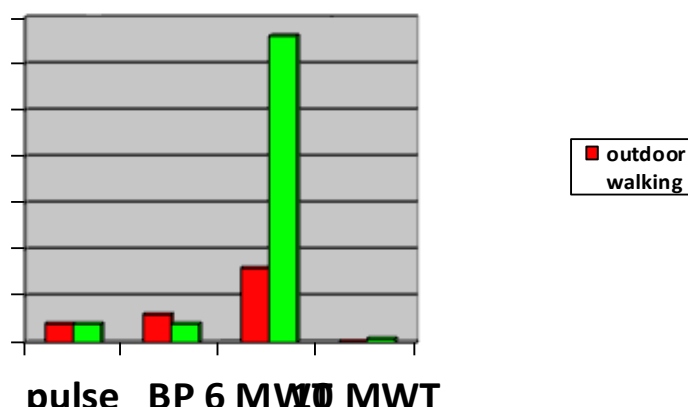


Figure No. 4.1: Mean differences in outcome measures

Discussion

The results of this study indicate that after three weeks, participants in treadmill group gained significant increase in the distance covered and the velocity of gait as compared to the participants in outdoor walking. This could be due to various reasons altered muscle work, calorie expenditure, artificial pace, controlled environment, safety, psychological factors, controlled weather, motivation, easy access to change room, placebo effect etc. However, the cause and effect relationship was not investigated since it was beyond the scope of this study. Similar results in different population have been reported by others.^{13,14} An increase in walking speed and distance indicating that treadmill walking was an effective and important tool in rehabilitation.

Second, the exercise on the treadmill also improved walking on a flat surface, as tested by the six minute walk test and 10 meter walk test. These results indicate that this type of exercise will be an excellent tool in different regions of the Iraq where the climate may

hinder outdoor activities. Also, it can be more motivating to walk on a treadmill than to walk in corridors, which often is the alternative to outdoor walking. The results of this study must therefore be seen in the light of the participants' total amount of activity, which was equal in the two groups. However, the difference in the exercise protocols was in the methods of walking exercise. Improvement in treadmill claudication distances in these patients translated into increased accelerometer-derived physical activity in the community, which enabled the patients to become more functionally independent¹⁵ We believe, therefore, that this difference must probably be the main explanatory factor for the improvement in the treadmill exercise group.

Pulse rates and blood pressure were recorded at rest and during activity and did not differ significantly between the groups indicating an endurance impact of the walking activity in both groups.

Implications of the study: This study can be a valuable help for exercise prescription in recreational athletes. The implications of this study could be that as and when possible, physical education expert may advice about treadmill walking as an effective way of improving exercise capacity to recreational athletes.

Strengths of the study: The strengths of this study included an adequate population sample that was fairly representative of recreational athletes.

Limitations of the study: Limitations of this study include relatively small groups and limited or no follow up after the study. The outcomes analyzed in this study were limited to walking performance and balance other factors such as motivational, psychological factors and oxygen consumption were not analyzed.

Unanswered questions: The unanswered question that arises at

this juncture is why there is no difference in cardio respiratory parameters of the participants who participated in outdoor and treadmill walking and what will be the long term or chronic effects of these two interventions.

New questions raised: The new questions that arise here is, what will happen if the same interventions are studied for long term, will there be any difference in cost effectiveness and patient preferences.

Recommendations: It is recommended that the future studies could be done with a larger homogenous sample, participants with similar gender and physical activity background by comparing energy expenditure and cost effectiveness.

Conclusion: Treadmill can be used as an effective option for improving exercise capacity and velocity of gait in rehabilitation of calf tears.

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