

Efficacy of OTO Power Stretch Apparatus in Training for Abdominal and Upper Body Muscular Endurance

OTO 力牽張儀在訓練腹部與上身肌肉耐力中的作用

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Abstract

The efficacy of the OTO Power Stretch apparatus in improving upper body muscular endurance and abdominal endurance was established in this study for a group of male and female adults. Results of the study demonstrated that participants increased their exercise endurance for the upper body and abdominal muscles significantly. Exercises using the OTO Power Stretch apparatus, done twice a day, over a training period of four weeks with thrice-a-week exercise sessions, can positively effect subcutaneous fat at the waist and abdomen in men, reduce body weight in men, reduce girth measurements in men, reduce hip girth in women, and increase upper arm and chest girth in women.

摘要

本文以成年男女為研究對象，應用 OTO 力牽張儀 (OTO POWER STRETCH APPARATUS) 對其進行了為期四周，每周三天，每天兩次的運動訓練。其結果顯示，訓練後受試者上身及腹部肌肉的耐力明顯增加。男性腰腹部皮下脂肪減少，體重與體圍下降，包括胸圍、腰圍、臀圍及臂圍等；女性臀圍下降，而臂圍和胸圍增加。

Introduction

Upper body muscular endurance, or the capability to perform a physical task repetitiously such as lifting, pulling or pushing, without too much fatigue, is a key component of health-related fitness (Chia, Leong, & Quek, 2002). Adequate abdominal endurance is important for the maintenance of good posture is also a preventative factor in the development of lower back pain (Ferguson, 1998). Additionally, regular body weight-bearing exercises such as those performed with the OTO Power Stretch apparatus are essential for the cultivation and maintenance of good bone health. Few studies have addressed efficacy issues in the use of home exercise apparatus such as those that purportedly train specific groups of trunk muscles. One study in this area focused on the

electromyographic analysis of selected abdominal exercises such as that reported by Seamons (1997) and another study examined the low back loads over a variety of abdominal exercises, in search for a safer abdominal challenge (Azler, & McGill, 1997). However, it appears that there are no studies that specifically address the efficacy of using such abdominal conditioning apparatus in controlled studies.

Most Singaporeans lead very busy lives and the lack of time for exercise is the oft-cited reason for not exercising (Chia, Leong, & Quek, 2002). OTO Power Stretch exercises are time-saving, can be performed in the comfort of the home, and when they are performed appropriately, can be a bonus to people who wish to keep 'muscle-endurance' fit but cannot spare the time

to exercise for 20 minutes or more. Importantly, the use of the OTO Power Stretch apparatus might be the impetus for previously sedentary persons to start being physically active on a daily basis.

The objective of the study was to examine the efficacy of the OTO Power Stretch apparatus in improving upper body and abdominal muscular endurance in a cohort of healthy male and female adults over a period of four weeks.

Methods

Description of the OTO Power Stretch Apparatus

The OTO Power Stretch apparatus, a home exercise apparatus, was encased in a tough, synthetic blue translucent 'beetle-shaped' casing that came with two detachable handles. The handles could be locked securely on assembly and were comfortable for a firm grip as no 'side to side' motion of the handles was possible. Four rubberised 'force-absorbing' wheels supported the apparatus. This allowed for non-slip use of the apparatus on any surface. The apparatus was also equipped with six robust recoil springs on either side of the handles. This provided consistent auto-retraction on the 'return phase' of the forward sliding motion. These special features in the OTO Power Stretch apparatus ensured that safety was not compromised during its use.

Participants

Participants were 60 male and female trainee teachers from the National Institute of Education, aged between 20 and 30 years old. All of them were volunteers and gave informed consent to participate in the study. The study had the requisite institutional ethical clearance. All the participants continued to be involved in normal recreational activities throughout the period of study and were not involved in any form of abdominal training prior to the study.

Conduct of the Study

Anthropometric (abdominal and waist skinfolds, waist, hip, upper arm & chest girths, stature & body mass) measurements were taken before & after the four-week period, in accordance to established procedures. Pre- and post-tests were conducted to determine the maximum number of repetitions that the participant could perform the exercise, in good form and without haste, in a standardized manner.

The maximum number of repetitions & the time taken to perform repetitions were recorded. After the pre-test, participants were randomly assigned to a CONTROL (15 male and 15 female) or a TRAINING GROUP (15 male and 15 female) in a matched manner, that is, they were matched in terms of their pre-test scores for the maximum number of repetitions they could perform using the OTO Power Stretch apparatus.

Participants in the CONTROL GROUP were instructed to carry on with their normal activities. Participants in the TRAINING GROUP adhered to the training outlined. All participants were instructed to adhere to normal patterns of eating and also to keep a food diary of what was eaten daily, over the period of four weeks. Prior to the conduct of the study, all participants reported that they had body weight stability (i.e. changes were within plus or minus 0.5 kg), over the previous two months.

Training Regimen

The principal investigator conducted the exercise sessions, three times a week and twice a day, over a period four weeks. Specifically, the training regimen is summarized as follows:

- WEEK 1: 70% of max rep X 3 sets
X morning & evening
- WEEK 2: 80% of max rep X 3 sets
X morning & evening
- WEEK 3: 90% of max rep X 3 sets
X morning & evening
- WEEK 4: 100% of max rep X 3 sets
X morning & evening

The passive rest interval between sets was 30 seconds.

Statistical Analysis

Data were stored in computer and analysed using Statistical Package for Social Science (SPSS Windows version 10.0). Descriptive statistics (mean and standard deviation) were generated for anthropometric measurements-body weight, girth and skinfold measurements, maximum number of repetitions, and the time taken to complete the maximum number of repetitions in good form, pre and post-test. Differences in the results between the pre and post-tests in males and females were analysed using repeated measures analysis of variance while differences between the performance of the TRAINING GROUP and CONTROL GROUP were analysed using one-way analysis of variance. The level of statistical significance was set at $P < 0.05$.

Results

All participants successfully completed the study. The time taken to perform each training session was less than 10 minutes. Participants in the CONTROL GROUP did not differ in their anthropometric measurements and muscular endurance performance over the two test occasions ($P>0.05$). In other words, they did not show any improvements in the measurements taken.

Contrarily, participants in the TRAINING GROUPS showed the following improvements that were statistically significant ($P<0.05$) over the two test occasions. These results are summarised in Tables 1 and 2.

Table 1. Data of the Male Participants in the TRAINING GROUP.

Training group [N=15]	Pre-test	Post-test
Age [y]	25.2±3.6	25.2±3.6
Height [m]	1.77±0.07	1.77±0.07
Weight [kg]	70.5±7.9	69.0±7.8 *
Abdominal skinfold [mm]	14±6	13±4 *
Waist skinfold [mm]	15±5	13±4 *
Upper arm girth [mm]	307±34	288±84 *
Chest girth [mm]	937±73	805±80 *
Waist girth [mm]	816±58	800±66 *
Hip girth [mm]	944±39	936±41 *
Max. no. of repetitions	24±4.8	35±6.6 *
Distance covered [m]	0.15±0.01	0.15±0.01
Time taken [s]	60±22	104±42 *

*Denotes significantly different at $P<0.05$ from pre-test result.

Table 2. Data of the Female Participants in the TRAINING GROUP.

Training group [N=15]	Pre-test	Post-test
Age [y]	24.1±2.4	24.1±2.4
Height [m]	1.61±0.07	1.61±0.07
Weight [kg]	54.0±9.3	54.1±10.7
Abdominal skinfold [mm]	13±4	13±3
Waist skinfold [mm]	14±5	14±4
Upper arm girth [mm]	249±22	254±23 *
Chest girth [mm]	790±33	851±43 *
Waist girth [mm]	695±71	699±73
Hip girth [mm]	894±49	886±48 *
Max. no of repetitions	17±6.6	34±5.6 *
Distance covered [m]	0.13±0.01	0.11±0.01
Time taken [s]	59±29	101±27 *

*Denotes significantly different at $P<0.05$ from pre-test result

Table 3. Data of the Male Participants in the CONTROL GROUP.

Control group [N=15]	Pre-test	Post-test
Age [y]	25.4±1.4	25.4±1.4
Height [m]	1.75±0.05	1.75±0.05
Weight [kg]	68.2±10.1	70.4±7.9
Abdominal skinfold [mm]	13±7	14±5
Waist skinfold [mm]	14±6	15±5
Upper arm girth [mm]	300±45	303±33
Chest girth [mm]	950±80	948±78
Waist girth [mm]	820±50	818±46
Hip girth [mm]	950±37	962±40
Max. no. of repetitions	23±14	23±12
Distance covered [m]	0.15±0.01	0.15±0.01
Time taken [s]	54±23	60±15

Table 4. Data of the Female Participants in the CONTROL GROUP.

Control group [N=15]	Pre-test	Post-test
Age [y]	25.1±2.0	25.1±2.0
Height [m]	1.63±0.05	1.63±0.05
Weight [kg]	53.0±10.0	54.1±10.7
Abdominal skinfold [mm]	27±11	28±15
Waist skinfold [mm]	21±10	22±16
Upper arm girth [mm]	252±33	255±40
Chest girth [mm]	837±26	842±21
Waist girth [mm]	685±27	687±31
Hip girth [mm]	897±55	899±65
Max. no. of repetitions	14±7	16±10
Distance covered [m]	0.14±0.01	0.12±0.01
Time taken [s]	52±12	62±10

The main results of the study are discussed. Reference is made to Tables 1 and 2 for participants in the TRAINING GROUP and Tables 3 and 4 for participants in the CONTROL GROUP.

Maximum Number of Repetitions Performed

- Female participants had a 100% improvement in their muscular endurance scores from their pre-test results (maximum number of repetitions: 17 ± 6.6 vs. 34 ± 5.6 , $P < 0.05$).
- Male participants had a 46% improvement in muscular endurance scores from their pre-test results (maximum number of repetitions: 24 ± 4.8 vs. 35 ± 6.6 , $P < 0.05$).

Time Taken to Perform the Maximum Number of Repetitions

- Male participants increased their exercise time from 60 ± 22 s to 104 ± 42 s, $P < 0.05$.
- Female participants increased their exercise time from 59 ± 29 s to 101 ± 27 s, $P < 0.05$.

Change in Body Weight

Male participants reduced their body weight from 70.5 ± 7.9 kg to 69.0 ± 7.8 kg, $P < 0.05$.

Skinfold Measurements

- Male participants reduced their abdominal skinfolds from 14 ± 6 mm to 13 ± 4 mm, $P < 0.05$.
- Male participants reduced their waist skinfolds from 15 ± 5 mm to 13 ± 4 mm, $P < 0.05$.

Girth Measurements

- Male participants reduced their upper arm girths from 307 ± 34 mm to 288 ± 84 mm; chest girths from 937 ± 73 mm to 805 ± 80 mm; waist girths from 816 ± 58 mm to 800 ± 66 mm; and hip girths from 944 ± 39 mm to 936 ± 41 mm (all $P < 0.05$).
- Female participants increased their upper arm girths from 249 ± 22 mm to 254 ± 23 mm. Their chest girth increased from 790 ± 33 mm to 851 ± 43 mm. Hip girth decreased from 894 ± 49 mm to 886 ± 48 mm (all $P < 0.05$).

Discussion

Most training studies have poor adherence due to a high drop out rate. For example, in a related study that compared two abdominal training devices with an abdominal crunch using strength and EMG measurements, the compliance was only 80% over 18 training sessions (Demont, Lephart, Giraldo, Giannantonio, Yuktanandana, & Fu, 1999). The present study had a 100% adherence, as there was no 'drop out'. In part, this had to do with the ease at which the actual exercises could be done, twice a day for three times a week and over a period of four weeks. The limited time required for completing each training session also contributed to the success of the study. The results showed that increasing upper body muscular endurance and abdominal endurance in terms of the maximum number of repetitions that could be performed were possible using the OTO Power Stretch apparatus.

Participants in the study were able to perform the exercise repetitions in good form and significantly increase their exercise time to exhaustion after 24 training sessions (i.e. three times a week, twice a day for four weeks). The result demonstrated that the participants were able to accomplish more work following training as their upper body and abdominal muscle endurance had increased significantly. Importantly, local muscular endurance of the arms, back and abdominal muscles increased 100% and 46% from their pre-training scores for the female and male participants in the post-training test. This was a real improvement over any 'learning effects' since participants in the CONTROL GROUP did not show any improvement in their scores over the two test occasions.

Male participants were able to reduce their body weight by a mean of 1.5 kg over a period of four weeks of training. These results contrast with the findings of Demont *et al.*, (1999) that showed no significant improvements in using two abdominal conditioning devices, Ab-Flexer and Ab-Roller, on measures of overall abdominal strength as assessed using maximum voluntary contraction (MVC) and peak isokinetic torque (ISO). The differences could be explained by the use of a non-specific and dissimilar test protocol as that used in the training in the cited study.

Another significant finding was that the male participants showed reductions in skinfold thickness taken at the waist and abdomen, and girth measurements for the upper arm, chest, waist and hip. These changes occurred in the absence of any statistically significant change in body weight. This may reflect the combined effect of a reduction in subcutaneous fat and also an improved muscle tone at the sites measured, after training. For the female

participants, there was a slight but statistically significant increase in upper arm and chest girths, after training. This is not unexpected since there could be some development of upper arm musculature following the training, given that most young women have underdeveloped upper body musculature. There was however, a reduction in hip girth from pre-training values, after training in the female participants.

Conclusion

The efficacy of the OTO Power Stretch apparatus in improving upper body muscular endurance and abdominal endurance was established in this study for a group of male and female adults. Results of the study demonstrated that participants increased their exercise endurance for the upper body and abdominal muscles significantly. Exercises using the OTO Power Stretch apparatus, done twice a day, over a training period of four weeks with twice-a-week exercise sessions, can positively effect subcutaneous fat at the waist and abdomen in men, reduce body weight in men, reduce girth measurements in men, reduce hip girth in women, and increase upper arm and chest girth in women.

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