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Abstract

The possibility of local reduction of subcutaneous fatty tissue was investigated in the project discussed in this article. Only one male participated in the experiment. During the experiment the participant trained his abdomen doing additional cardio training for two weeks, while in the following two weeks the abdomen was not trained at all. Instead of abdomen training, only cardio training was performed. This was repeated until the end of the experiment which lasted 9 weeks. The sum of thickness of all 7 observed skin folds was counted. Then, percentage of thickness of abdomen skin folds in relation to all skin folds was calculated. Each successive measurement was compared with the previous one to assess the decrease or increase of abdomen skin fold percentage in relation to all measured skin folds. We put the decreases and increases into a contingency table and calculated probability by using the Fisher's exact test. Statistical significance was determined at 0.05 level. The local reduction of subcutaneous fatty tissue at abdomen was proven. However, the problem needs more scientific results to conclude this question completely.

Keywords: local reduction of body fat, cardio training, strength training, fat burning.

Introduction

Obesity presents a serious problem in the modern world. We can look at obesity from a medical as well as from an aesthetical point of view. Losing weight has its pros and cons. The positive effects include lesser strain of joints, lesser risk of cardiovascular diseases and lesser risk of diabetes mellitus

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(Buková, 2011, Liba, Buková, 2012, Cepková, 2010). However, from the aesthetical point of view, less fat can cause deepening of wrinkles, diminishing of breasts, or losing fat from undesired parts.

Strength training can form figure on the base of focused building of muscles in particular parts of the body. Furthermore, the benefits of strength training can also be observed in the senior population (Uher, 2010, Uher, Buková 2011). Nevertheless, it appears problematic to shape the body by burning fat in individual body parts. This is a very important finding especially for individual sports like rhythmic gymnastics (Pullmannová Švedová, 2010, Švedová, 2004) It is not scientifically proven, but it is not refuted either, that it is impossible to focus fat burning on individual parts of the body.

It is believed that spot reduction, i.e. exercise-induced localized loss of subcutaneous fatty tissue, does not occur as a result of exercise program (Foss, Keteyan, 1998, Loskot, 2011, Mach 2007). On the other hand, local reduction of subcutaneous fatty tissue was proven in some other studies (Krotkiewski, 2009, Stallknecht et al. 2006, Kostek et al. 2007, Olson, Edelstein, 1968); However, the evidence as a whole has been inconsistent (Kostek et al., 2007).

The well-known practice of bodybuilding consists in increasing the number of repetitions on abdomen muscle exercises for burning more fat in that area (Feč, 2007). Former Czech bodybuilding champion and current sport scientist "Tlapak" also states that local reduction is possible (Mach, 2007). His opinion stems from his own extensive experience in burning body fat, as well as from his scientific experiments in this area, which could insinuate the possibility of local reduction (Mach, 2007). Generally, nowadays the opinion in bodybuilding prevails that local reduction of body fat is impossible (McDonald, 2008; Feč, 2010 a).

We did not confirm local reduction of subcutaneous fat in the experiments carried out by students of Pedagogical Faculty (Feč, 2010 b, c; Feč, 2012). This means that in our experimental groups the decrease of fat skin folds was not influenced by focusing strength training on the body parts observed.

One has to meet 3 conditions in regard to burning fat locally. Firstly, fat has to be broken down in the adipose tissue; secondly, the fatty acids must be taken by blood flow to the body and thirdly, they must be burnt. Blood flow and lipolysis are generally higher in subcutaneous fat adjacent to contracting than that adjacent to the resting muscle, irrespective of exercise intensity (Stallknecht et al., 2006). Thus, specific exercises can induce "spot lipolysis" in adipose tissue. The purpose of strength training is to initiate breaking down of fat and bringing blood to the fatty tissue situated near the exercised muscles. The purpose of cardio training is to burn fatty acids in the blood. The question stands whether it is possible to locally decrease thickness of subcutaneous fat by a combination of strength and aerobic training.

Objective

The objective of our research was to ascertain whether it is possible to decrease thickness of subcutaneous fat in abdomen to a greater extent than in the other areas of the body.

We presume that there will be a greater decrease of subcutaneous fat at abdomen in comparison with the other areas observed.

Research methods

The case study lasted for nine weeks. Only one male, 23 years of age, with previous cocker history participated in the experiment. During the experiment the participant trained his abdomen by doing additional cardio training for two weeks, while in the successive two weeks the abdomen was not trained at all. Instead of training the abdomen, only cardio was performed. This was repeated until the end of the experiment. The program concerning training the abdomen and cardio was the following:

Experimental weeks (Abdomen training):

Training of abdomen lasted for 10 min., followed immediately by 5 minutes of rope jumping. This pattern was repeated 3 times with no rest between the exercises. It means that the whole training session lasted for 45 minutes with no rest between the exercises. This was repeated 3 times per week.

Abdomen training consisted of 3 exercises which were altered as follows:

1. sit ups
2. lifting legs lying on the floor with no contact of leg with the floor
3. alternating of curling and stretching left and right leg lying on the floor

After accomplishing exercise 3, exercise 1 followed again. The exercises were altered according to the participant's subjective feeling.

Non-experimental weeks:

Continuous, 45-minute running session was performed 3-times per week during non-experimental weeks.

The participant performed strength training 3-times a week during the experiment, regardless of training during the experimental or non-experimental weeks. Strength training was performed on the days when the participant did not train the abdominals or did running in experimental or non-experimental week. Strength training was altered with abdomen training or running during the week. The participant had a one-day rest each week.

We reduced caloric intake of the participant by 20% to assure weight loss.

A caliper was used to measure subcutaneous fat. The pressing force of caliper determined by international agreement was 10p per mm^2 and the size of the pressing surface was at least 40 mm^2 (Chytráčková 1999).

We measured subcutaneous fat in seven points of the body and calculated percentage of body fat according to Jackson, Pollock (1985).

Skinfolds:

— chest (diagonal fold) – one-half of the distance between the anterior axillary line and the nipple
— midaxillary (vertical or horizontal fold) – midaxillary line at the level of the xiphoid process of the sternum
— abdomen (vertical fold) – 2 cm to the right side of the umbilicus
— suprailiac (diagonal fold in line with the natural angle of the iliac crest) - anterior axillary line immediately superior to the iliac crest
— subscapular – diagonal fold 1 to 2 cm below the inferior angle of the scapula
— thigh (vertical fold) – anterior midline of the thigh, midway between the proximal border of the patella (upper knee) and the inguinal crease (hip)
— triceps (vertical fold) – posterior midline of the upper arm, halfway between the acromion (shoulder) and olecranon processes (elbow)

The sum of thickness of all 7 skin folds was counted. Subsequently, the percentage of thickness of abdomen skin folds was calculated in relation to all skin folds. Every following measurement was compared with the previous one to assess the decrease or increase of abdomen skin fold percentage in relation to all measured skin folds. We put the decreases and increases into a contingency table and calculated probability by using Fisher's exact test. Statistical significance was determined at 0.05 level.

Results

The bodyweight of the participant at the beginning of the experiment was 76.5 kg (Tab. 1). According the percentage of body fat, which was 13.66%, he was classified as lean. The weight of fat was 10.45 kg. The thickness of his abdomen skin fold at the beginning of experiment was 21 mm.

Table 1. Basic indicators of the participant at the beginning and at the end of experiment

Thickness of skin folds in mm	First Measurement	Last Measurement	Difference
Chest	8.5	3.5	−5
Midaxillary	12	5	−7
Abdominal	21	7.5	−13.5
Suprailiac	18	9	−9
Thigh	15	9.5	−5.5
Subscapular	11.5	7	−4.5
Triceps	10	7	−3
Sum of 7 skinfolds	96	48.5	−47.5

Table 1. Basic indicators of the participant… (cont.)

Thickness of skin folds in mm	First Measurement	Last Measurement	Difference
% of fat	13.66	7.00	−6.66
Body weight (kg)	76.5	68	−8.50
Weight of fat (kg)	10.45	4.76	−5.69
Active body mass (kg)	66.05	63.24	−2.81

At the end of experiment, the participant's bodyweight was 68 kg, which represents a decrease of 8.5 kg in 9 weeks. He burned 5.69 kg of fat. However, he also lost 2.81 kg of lean body mass. His percentage of body fat decreased from 13.66 to 7.00 mm. The thickness of the participant's abdomen skin fold lessened by 13.5 mm.

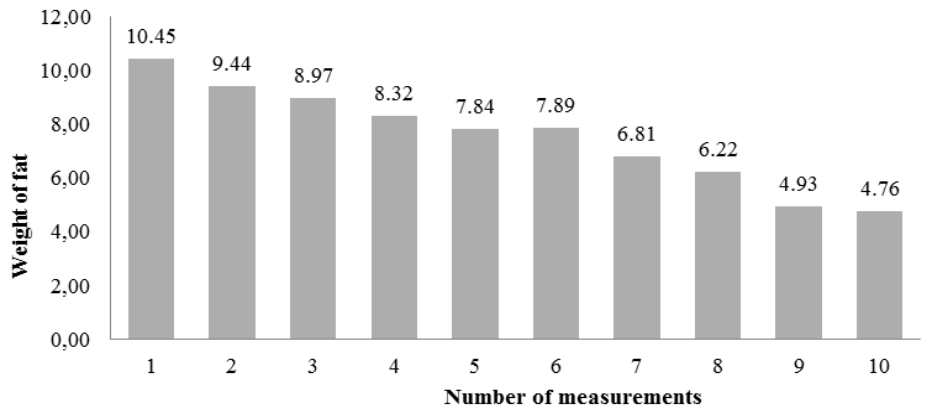

Figure 1. The decrease of weight of fat in the consecutive weeks of the experiment

Changes of percentage in abdomen skin fold in relation to thickness of all skin folds are presented in Table 2.

Table 2. Increases and decreases of percentage of abdomen skin fold in relation to thickness of all skin folds

Number of Weeks	1	2	3	4	5	6	7	8	9	10
Abdomen/ Running Weeks		Abdomen Workout		Running		Abdomen Workout		Running		Abdomen Workout
% of Abdo-men Thickness	21.8	**19.058**	**16.56**	**15.28**	15.54	**15.33**	**14.39**	15.57	16.16	**15.46**
Increase/ decrease		–	–	–	+	–	–	+	+	–

Generally, the participant lost almost 9 kg of body weight, which accounts for almost 1 kg of body weight per week. This means that his caloric intake was adjusted correctly. We can see continual decrease of the participant's weight of fat equalling to 0.5 – 1 kg of fat per week (Figure 1). Only in the 6th week did we notice a slight increase of fat weight because due to failure in keeping to our recommendations.

The decreases in percentage of abdomen skin fold when the abdomen was exercised is obvious. However, only once we observed a decrease of abdomen percentage in the week when running was applied. This clearly insinuates influence of our combination of strength and aerobic training on local reduction of subcutaneous fat in the abdomen area.

Table 3. Decreases and increases of percentage of abdominal skin fold in relation to thickness of all observed skin folds

	Increase	Decrease
Abdomen training	0	5
Running	3	1

Table 3 shows the number of decreases and increases of percentage of abdomen skin fold related to experimental weeks when the abdominals were trained and the reference weeks when running was applied instead of abdomen training. Probability according to Fisher's exact test was $p = 0.0476$, which presents a significant value. This means that our hypothesis stating the possibility to reduce body fat locally was confirmed.

Discussion

Science does not accept a declaration that such a local reduction of body fat is possible (Foss, Keteyan, 1998; Loskot, 2011; Mach, 2007; Kostek et al. 2007); However, the concept was not refuted. We think that the problem lies in the training protocol. We also did not prove local reduction of body fat in our previous research ((Feč, 2010 b, c; Feč, 2012) where we carried out the study on untrained women. The reason why local reduction was not proven in that research might have been due to insufficient intensity. Therefore, in this work we focused our attention entirely on the trained individual. In spite of high intensity, local reduction of body fat was not proven in our unpublished research, since only strength training was applied. Subcutaneous fats represent an extensive source of energy.

Energy source in subcutaneous fat is so substantial that decreases in thickness of subcutaneous fat due to training focused on local reduction are negligible (McDonald, 2008). Because of the above fact, we focused our training protocol not only on intensity but also on volume. Our training protocol comprised a combination of abdominal training followed by cardio training, according to

recommendations of Loskot (2011). The intensity and volume represented by cardio training could cause that in our research local reduction was statistically proven. As a result, we can agree with Krotkiewski, (2009), Stallknecht et al. (2006), Kostek et al. (2007), Olson, Edelstein, (1968) that exercise-induced local reduction of subcutaneous fat is possible. Since our research was performed only on one participant, positive results cannot be generalized. The problem needs more research to conclude this topic ultimately.

Conclusion

We can conclude that the hypothesis in our experiment was proven. This means that local fat reduction was possible. Since only a single participant took part in our experiment, we cannot definitely conclude that local reduction is generally possible, in spite of confirming our hypothesis. The problem needs more research to draw a definite conclusion.

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Streszczenie

Studium przypadku wpływu siłowego i wytrzymałościowego treningu na lokalną redukcję podskórnej tkanki tłuszczowej

W artykule przedstawiono możliwości redukcji lokalnej podskórnej tkanki tłuszczowej. Badania przeprowadzono na jednym przedstawicielu płci męskiej. Podczas eksperymentu badany trenował mięśnie brzucha w kombinacji z treningiem aerobowym przez dwa tygodnie. Następne dwa tygodnie mężczyzna wykonywał tylko trening wytrzymałościowy i nie trenował w ogóle mięśni brzucha. Powtarzano to do czasu zakończenia eksperymentu, który trwał przez dziewięć tygodni. Obliczono całkowitą grubość obserwowanych 7 fałdów skórnych. Następnie obliczono wartość procentową tworzoną przez grubość fałdu skórnego na brzuchu względem sumy wszystkich fałdów skóry. Każdy kolejny pomiar porównywano z poprzednim, aby sprawdzić, czy stosunek procentowy grubości fałdu skórnego na brzuchu do grubości wszystkich fałdów skóry wzrośnie czy zmaleje. Wyniki pomiarów zestawiono w tabeli, a prawdopodobieństwo błędu obliczono przy pomocy testu Fiszera. Jako istotną statystycznie przyjęto wartość 0,05.

Badania wykazały lokalną redukcję podskórnej tkanki tłuszczowej na brzuchu, ostateczne rozstrzygnięcie przedmiotowej kwestii wymaga jednakże dalszych badań.

Słowa kluczowe: lokalna redukcja tkanki tłuszczowej, trening wytrzymałościowy, trening siłowy, spalanie tłuszczu.