The Influence of Habitual Exercise Training and Meal Form on Diet-Induced Thermogenesis in College-Age Men

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This study compared type of habitual exercise and meal form on diet-induced thermogenesis (DIT) in 29 men age 19–28 yr. Resting metabolic rate (RMR) and DIT response to solid-meal (bar) vs. liquid-meal (shake) ingestion were measured via indirect calorimetry; classifications were sedentary (n = 9), endurance trained (n = 11), or resistance trained (n = 9). Height, weight, and body composition (using bioelectrical impedance) were measured for each subject. Energy expenditure was determined before and every 30 min after meal consumption for 210 min. RMR was significantly (p = .045) higher in the endurance- and resistance-trained groups. However, when expressed per kilogram fat-free mass (FFM; relative RMR), differences were not significant. Both DIT (kcal/min) and relative DIT (kcal · min⁻¹ · kg FFM⁻¹) significantly increased with time (p < .0001) from RMR for each meal form. There was no significant exercise-group effect on DIT or relative DIT. There was a significant (p = .012) effect of meal form on DIT; shakes elicited a higher DIT. This significant difference was not found for relative DIT. There was a significant interaction between group and meal form for DIT (p = .008) and relative DIT (p < .0001). Shakes elicited a significantly greater DIT (p = .0002) and relative DIT (p = .0001) in the resistance-trained group. In the sedentary group, relative DIT from shakes was significantly lower than from bars (p = .019). In conclusion, habitual exercise appears to increase RMR, and meal form may impart changes in relative DIT depending on exercise status.

Keywords: physical activity, metabolic rate, thermic effect of food

Although energy intake simply refers to calories ingested in the form of food and drink, energy output is made up of three individual components: resting metabolic rate (RMR), physical activity, and diet-induced thermogenesis (DIT), also known as thermic effect of food. The proportions contributed to energy expenditure from each component vary per person. RMR as a percentage of energy expenditure tends to change as physical activity decreases or increases (Weststrate & Hautvast, 1990); in fact, RMR can account for as much as 80% of total energy expenditure in a very sedentary person or as little as 30% in someone with high exercise levels (Tremblay, Despres, & Bouchard, 1985). Physical activity may contribute only 15% of overall energy expenditure in an extremely sedentary individual but usually contributes approximately 30% in normal individuals (Poehlman, Melby, Badylak, & Calles, 1989). DIT is defined as the postprandial change in resting energy expenditure after food consumption. It includes the energy used for digestion, absorption, and nutrient storage (Tremblay et al., 1985); it is thought to account for ~10% of total energy expenditure (Oba et al., 1999; Weststrate & Hautvast 1990). Although this represents a small portion of total energy expenditure, this may be an important component over time with respect to combating the current obesity epidemic (King & Tribble 1991; Oba et al., 1999).

Because increased energy expenditure through exercise is often prescribed to shift the energy balance to a negative state, it is important to understand how exercise can influence RMR and DIT. However, research focused on the effects of different types of exercise on both RMR and DIT is limited at best. Endurance exercise has been shown to increase RMR in several studies (Poehlman, Arciero, Melby, & Badylak, 1988; Poehlman, Melby, & Badylak, 1989; Sjodin et al., 1996), whereas other studies have not reported similar findings (Horton et al., 1994; Thorne & Wahren, 1989; Westerterp, Meijer, Schoffelen, & Janssen, 1994). Unfortunately, none of these studies included DIT measurements. Far less research has investigated the metabolic effects of resistance exercise (weight lifting),
but a study by Thyfault, Richmond, Carper, Potteiger, and Hulver (2004) showed that resistance exercise can increase both RMR and DIT. To date, the effects of endurance and resistance training on both RMR and DIT have not been studied, yet it is absolutely essential that this be done. If exercise is to be encouraged as a means of combating obesity, it is vital to have a better understanding of the effects of various exercise types on RMR and DIT.

Moreover, a thorough picture of exercise and energy balance is not complete without some focus on the effects of meal form and nutrient composition on DIT. It appears that each can affect at least the first few hours of DIT. Increasing the energy content of a meal produces a significant increase in DIT (Belko, Barbieri, & Wong, 1986; Samueloff, Beer, & Blondheim, 1982). In terms of macronutrient composition, increasing the protein content of a meal tends to increase DIT compared with fat and carbohydrate (Belko et al., 1986; Raben, Agerholm-Larsen, Flint, Holst, & Astrup, 2003; Riggs, White, & Gropper, 2007). In addition, DIT has been shown to be altered with different meal forms. When a meal consisting of solid foods and liquid was compared with a homogenized meal of equal volume, calories, and macronutrient composition, homogenized meals resulted in a significantly greater DIT than the typical solid+liquid meal (Peracchi, Santangelo, et al., 2000). However, the contribution of different meal forms of similar macronutrient composition in combination with the type of habitual exercise performed has not been studied. The importance of such research cannot be understated, especially with the rapid emergence of exercise- and energy-balance-related nutrition products. Therefore, the purpose of this study was to determine the possible effects of endurance and resistance exercise on RMR and DIT after the consumption of different meal forms (solid vs. liquid) in college-age men.

Methods

Participants

A total of 42 men, age 19–28 years, were recruited via flyers across the campus of Auburn University. Each potential participant was initially screened over the phone or through e-mail to ensure he met the criteria to be classified as resistance training (three or more 1-hr weight-lifting sessions per week), endurance training (regular running or jogging for more than 1 hr/week), or sedentary (no more than two half-hour exercise sessions per week). Definitions of each classification were based on previously published studies (Meijer, Janssen, et al., 1991; Treuth, Hunter, Weinsier, & Kell, 1995). Subjects were excluded from the study if they did not meet age requirements or the definitions for resistance training, endurance training, or being sedentary; had had a recent change in exercise patterns; used stimulant or depressant medications; currently followed a strict fad or medically prescribed diet; or had a nut, chocolate, or milk allergy. Subjects were not excluded if currently using or consuming alcohol, tobacco, caffeine, or dietary supplements, but they were asked to refrain from using these, as well as exercising, for 24 hr before laboratory visits during which metabolism was measured. In addition, subjects were asked to refrain from tobacco products the morning of their visits. Of the 42 possible participants recruited, 10 did not meet the research criteria, and 3 dropped out after Visit 1 and therefore were excluded from the study. A total of 29 participants (n = 9 sedentary, n = 11 endurance, and n = 9 resistance) completed the study, which was approved by Auburn University’s institutional review board.

Study Design

This study was performed using a crossover design in which participants reported twice for a total of approximately 8 hr. Visit 1 included completion of the medical- and exercise-history questionnaires, as well as informed-consent documentation. This visit also included height and weight measurements and body-composition (body fat, percent fat-free mass, and percent body water) measurements via bioelectrical-impedance analysis (Tanita Co., Arlington Heights, IL). Each subject’s body-mass index (BMI) was calculated from height and weight. Participants were randomly assigned to Meal Group 1 (solid meal on the first trial and liquid meal on the second) or Meal Group 2 (liquid meal on first trial and solid meal on the second). Each meal consisted of 570 calories and varied in form (solid vs. liquid); solid meals were three Slim-Fast high-protein bars (Slim-Fast, Inc., Englewood, NJ), and liquid meals were three Slim-Fast high-protein shakes (Slim-Fast, Inc.). The meals varied in carbohydrate and fat content by 4% each. The solid meals (bars) were 42% carbohydrate, 31% protein, and 27% fat. The liquid meals (shakes) were 46% carbohydrate, 31% protein, and 23% fat.

Experimental Measurements

Subjects reported to the laboratory between 6:00 and 7:00 a.m., with the exception of 1 subject who reported at 9:00 a.m. because of his work schedule. They were often met at their place of residence and transported to the laboratory by one of the researchers, although some participants were transported by a friend or roommate. On arrival and before RMR measurement, subjects rested quietly in a semireclined comfortable chair for 10 min in a dimly lit room at approximately 72 °F (22 °C). RMR and DIT were measured via indirect calorimetry with MedGem (Healthtech, Golden, CO), a handheld, FDA-approved device that has been validated to measure RMR (Stewart, Goody, & Branson, 2005) and DIT (St-Onge, Rubiano, Jones, & Heymsfield, 2004). All energy-expenditure measurements took 8–10 min and were performed with subjects in a semireclined position. Subjects were given 20 min to consume the meal,
directly after which energy expenditure was measured every 30 min for the next 3.5 hr. During the periods in which energy expenditure was not being measured, they were allowed to read, study, or continue resting quietly and were provided with water and bathroom breaks as needed. Visit 2 was similar in experimental design except for the change in meal form and lack of body-composition measurements. The time between Visit 1 and Visit 2 was a minimum of 4 days and did not exceed 21 days. The researcher conducting the energy-expenditure measurements was blinded to the form of meal the subject had consumed. The coefficient of variation (CV) for RMR measurements was 6.5%. The interindividual CVs for the sedentary, endurance, and resistance groups were 45.2%, 48.5%, and 45.4% respectively.

Statistical Analysis
Statistical analyses were performed using SPSS Version 16.0 (SPSS, Inc., Chicago, IL) or JMP 7.0.2 (SAS Institute, Inc., Cary, NC). Analysis of variance (ANOVA) was used to detect possible significant \((p < .05)\) differences in age, BMI, fat-free mass (FFM; kg), percent FFM, percent body fat, percent body water, RMR, relative RMR, DIT, and relative DIT. Relative RMR and relative DIT were calculated as RMR and DIT, respectively, divided by kg FFM (Poehlman, Arciero, et al., 1988; Thyfault et al., 2004; Tremblay, Cote, & LeBlanc, 1983). Repeated-measures ANOVA (restricted or residual maximum likelihood) was used to determine the main effects of time (of the 3.5-hr DIT period), meal form, and training state, as well as their interactions. The effect of subject across time was also included in the model with random effects assigned to subjects. When a significant \((p < .05)\) difference was found, post hoc multiple comparisons were made via least-square mean differences or orthogonal contrasts.

Effects on RMR and Relative RMR
RMR and RMR corrected for kg FFM (relative RMR) are shown in Table 1. RMR was significantly greater in the endurance and resistance groups than the sedentary group \((p = .045)\). There was no significant difference in RMR between the endurance- and resistance-exercise groups (Table 1). These results were no longer significant when relative RMR was analyzed (Table 1). There was a weak but significant positive correlation between BMI and RMR \((r = .148; p = .039)\).

Effects on DIT and Relative DIT
The main effects on DIT and relative DIT are highlighted in Figures 1 and 2. Figure 1 shows the change in postprandial energy expenditure (DIT) over time after consumption of bars (Figure 1A) and shakes (Figure 1B). Figure 2 shows DIT corrected for kg FFM (relative DIT) for consumption of bars (Figure 2A) and shakes (Figure 2B) over the course of the study. There was

### Table 1  Age, Body-Mass Index, Fat-Free Mass, Body Fat, Body Water, Resting Metabolic Rate (RMR), and Relative RMR Among Sedentary, Endurance-Trained, and Resistance-Trained Subjects, \(M \pm SE\)

<table>
<thead>
<tr>
<th></th>
<th>Sedentary ((n = 9))</th>
<th>Endurance ((n = 11))</th>
<th>Resistance ((n = 9))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>22.1 ± 1.5(a)</td>
<td>22.7 ± 1.9(a)</td>
<td>21.8 ± 2.5(a)</td>
</tr>
<tr>
<td>Body-mass index (kg/m²)</td>
<td>23.8 ± 3.0(a)</td>
<td>24.6 ± 2.5(a)</td>
<td>24.4 ± 2.4(a)</td>
</tr>
<tr>
<td>Fat-free mass (kg)</td>
<td>64.8 ± 1.9(a)</td>
<td>68.0 ± 2.1(a)</td>
<td>66.9 ± 1.6(a)</td>
</tr>
<tr>
<td>Body fat (%)</td>
<td>15.3 ± 2.1(a)</td>
<td>14.8 ± 1.4(a)</td>
<td>14.2 ± 1.3(a)</td>
</tr>
<tr>
<td>Body water (%)</td>
<td>61.9 ± 1.6(a)</td>
<td>62.5 ± 1.0(a)</td>
<td>62.8 ± 1.0(a)</td>
</tr>
<tr>
<td>RMR (kcal/min)</td>
<td>1.32 ± 0.05(a)</td>
<td>1.46 ± 0.04(b)</td>
<td>1.47 ± 0.04(b)</td>
</tr>
<tr>
<td>Relative RMR (kcal · min⁻¹ · kg fat-free mass⁻¹)</td>
<td>0.020 ± 0.0005(a)</td>
<td>0.022 ± 0.0004(a)</td>
<td>0.022 ± 0.0009(a)</td>
</tr>
</tbody>
</table>

Note. Values in rows with different subscripts differ significantly \((p < .05)\).
Figure 1 — Diet-induced thermogenesis (DIT) among sedentary (closed circles; \( n = 9 \)), endurance-trained (open circles; \( n = 11 \)), and resistance-trained (closed triangles; \( n = 9 \)) subjects after consumption of (A) bars and (B) shakes, \( M \pm SE \). Results are expressed as change in energy expenditure from resting metabolic rate.

Figure 2 — Diet-induced thermogenesis (DIT) corrected for fat-free mass (FFM) among sedentary (closed circles; \( n = 9 \)), endurance-trained (open circles; \( n = 11 \)), and resistance-trained (closed triangles; \( n = 9 \)) subjects after consumption of (A) bars and (B) shakes, \( M \pm SE \). Results are expressed as change in energy expenditure from resting metabolic rate divided by kg FFM.

A significant \( (p < .0001) \) effect of time (210-min DIT period) on DIT (kcal/min) and relative DIT (kcal \( \cdot \) min\(^{-1} \) \cdot kg FFM\(^{-1} \)). Overall, energy expenditure increased 30 min after meal consumption, peaked at 60 min, and began to decrease toward baseline after consumption of both bars and shakes. It should be noted that even at 210 min postconsumption, energy expenditure was greater than at baseline in both meal types.

Effects of Meal Form, Exercise Group, and DIT Time Period

Figure 3A shows overall DIT expressed as the average change in energy expenditure over 210 min, and Figure 3B shows the relative DIT expressed as the average change in energy expenditure over 210 min corrected for FFM. There was no significant effect of exercise...
group on DIT or relative DIT for bars (Figure 1A). Although the resistance group had a somewhat greater DIT and relative DIT after consuming shakes (Figures 2 and 3) than the sedentary and endurance groups, it was not significant for DIT \((p = .082)\) or relative DIT \((p = .126)\).

Across all subjects, there was a significant \((p = .012)\) effect of meal form on DIT. Consuming shakes produced a greater DIT \((0.28 \pm 0.02 \text{ kcal/min})\) than consuming bars \((0.24 \pm 0.02 \text{ kcal/min})\); however, there was no significant \((p = .376)\) effect of meal form when DIT was corrected for FFM \((\text{bars} = 0.0036 \pm 0.0004 \text{ kcal \cdot min}^{-1} \cdot \text{kg FFM}^{-1}, \text{shakes} = 0.0038 \pm 0.0004 \text{ kcal \cdot min}^{-1} \cdot \text{kg FFM}^{-1})\).

**Interactions Between Meal Form, Exercise Group, and DIT Time Period**

There was a significant \((p = .008)\) interaction between exercise group and meal form for DIT. This interaction was only present in the resistance group. DIT from shakes \((0.36 \pm 0.04 \text{ kcal/min})\) in the resistance group was significantly \((p = .0002)\) greater than DIT from bars \((0.24 \pm 0.05)\) in the resistance group. There was no significant difference between meal forms in the sedentary or endurance groups. In addition, when relative DIT was analyzed, there was a significant \((p < .0001)\) interaction between group and meal form. In the resistance group, shakes elicited a significantly \((p = .0001)\) greater relative DIT \((0.0050 \pm 0.0002 \text{ kcal \cdot min}^{-1} \cdot \text{kg FFM}^{-1})\) than bars \((0.0037 \pm 0.0007 \text{ kcal \cdot min}^{-1} \cdot \text{kg FFM}^{-1})\). The opposite effect was seen in the sedentary group. Shakes had a significantly \((p = .019)\) lower relative DIT \((0.0031 \pm 0.0006 \text{ kcal \cdot min}^{-1} \cdot \text{kg FFM}^{-1})\) than bars \((0.0039 \pm 0.0007 \text{ kcal \cdot min}^{-1} \cdot \text{kg FFM}^{-1})\).

There was no significant interaction between exercise group and time, time and meal form, and exercise group, time, and meal form for DIT or relative DIT.

**Discussion**

The purpose of this study was to determine whether the type of exercise performed by college-age men on a regular basis influences energy expenditure through alterations in RMR or DIT. In addition, we investigated whether the form of meal consumed by these individuals alters DIT. We found that subjects who were regularly involved in endurance or resistance exercise had higher RMR than those who were not involved in regular physical exercise. We also found that there was no overall effect of exercise group on DIT, but the type of meal consumed has an interactive effect with the type of exercise performed. Therefore, these studies suggest that habitual exercise regimens can increase energy expenditure through alterations in RMR in this age group, but the effects on postprandial energy expenditure may be more subtle depending on the type of meal consumed and type of habitual exercise performed.

In the current study, subjects who engage in regular exercise (either endurance or resistance training) had significantly greater RMR than sedentary individuals. This finding is similar to those of other studies comparing endurance- or resistance-trained individuals with sedentary individuals (Byrne & Wilmore 2001;...
Poehlman, Arciero, et al., 1988; Poehlman et al., 1989; Thorne & Wahren, 1989; Thyfault et al., 2004); however, it should be noted that none of those studies compared RMR for endurance- and resistance-trained subjects. Although alterations in RMR can be attributed to many parameters, the amount of FFM is usually considered the main determinant (Stiegler & Cunliffe 2006). Dietary or exercise interventions that result in weight loss are usually associated with decreased RMR because of failure to maintain FFM (Menozzi et al., 2000). This, in fact, may be a critical factor for most individuals who gain weight back after repeated episodes of weight loss (Byrne et al., 2003). Evidence that FFM contributes to differences in RMR in the current study is seen when RMR is corrected for FFM. The statistically significant difference in RMR between the endurance- and resistance-trained and sedentary groups was no longer present after accounting for the presence of FFM. Because there were no significant differences in kg FFM between any of the groups studied, we conclude that the increased RMR observed in the endurance and resistance groups is most likely a result of the presence of more metabolically active tissue as a result of habitual exercise performed at high levels of intensity. Numerous studies have concluded that intense exercise can increase RMR (Poehlman, Arciero, et al., 1988; Poehlman et al., 1989; Weststrate & Hautvast 1990). Subjects in both Poehlman et al. studies (Poehlman, Arciero, et al., 1988; Poehlman et al., 1989) were highly trained, competitive endurance athletes, as were those in Thorne and Wahren’s study. Exercising subjects in the current investigation were not necessarily competitive athletes on a college team (although some endurance exercisers were members of a cycling club), but all were frequent exercisers, often at an intense level. It is more likely that exercise, regardless of the type, at a habitually moderate or greater level of intensity, common to both the endurance-trained and resistance-trained subjects in this study, increases the proportion of highly metabolically active tissue in the body.

One possible confounding variable that may account for the increased RMR in both exercising groups is the residual effect of recent exercise. The current study was conducted at least 24 hr postexercise, a time frame that appears to minimize the residual effects of exercise (Poehlman et al., 1989). If subjects in both exercising groups had not followed protocol, that could contribute to increased RMR. This is a possibility, but with the significance of each exercising group’s RMR being above that of the sedentary group, coupled with the proximity of within-group RMR measurements, this explanation is unlikely. In addition, subjects were routinely questioned before RMR measurements to ensure that they had adhered to the protocol guidelines.

No significant effect of exercise group was found for DIT or relative DIT in subjects consuming bars or shakes. This lack of significance may be a bit surprising with respect to body composition. One might hypothesize that if the exercise groups have a body composition similar to the sedentary group, the exercise groups regularly ingested more food than their sedentary counterparts, and they may then demonstrate a significantly greater DIT. However, this was not the case, and these results are consistent with several studies that found no influence of either acute or habitual exercise training on DIT (Ohnaka et al., 1998; Samueloff et al., 1982; Thorne & Wahren, 1989). In contrast, Thyfault et al. (2004) found that resistance training increased postprandial energy expenditure. However, this effect was only seen with the consumption of a high-carbohydrate meal. When a moderate-fat meal was consumed there was no difference in exercise group and DIT. The authors concluded that carbohydrate oxidation is the primary determinant in DIT. Compared with Thyfault et al., our diets contained only 42–46% carbohydrate. This may explain the differences in responses to DIT in these studies. Denzer and Young (2003) also found that resistance exercise increased DIT; however, that study used acute bouts of resistance exercise, whereas the current study and the study by Thyfault et al. were based on habitual exercise. Several studies have also reported that sedentary groups have greater DIT (LeBlanc, Mercier, & Samson, 1984; Poehlman, Arciero, et al., 1988; Tremblay et al., 1983) than trained subjects. However, the contradiction between those studies and the current study may be influenced by subjects’ gender or fitness level of subjects.

There was an overall effect of meal form on DIT. Consuming a liquid meal in the form of shakes resulted in increased DIT compared with a solid meal (bars). However, this effect was not seen when data were normalized to FFM. Peracchi et al. (2000) found that homogenization of meals results in a significantly greater DIT response than with a typical solid meal. The most likely explanation for an increased DIT from a liquid meal is the fact that liquids empty from the stomach faster than solids and therefore would be expected to be absorbed more quickly (Carbonnel, Lemann, Rambaud, Mundler, & Jian, 1994; Habas & Macdonald 1998). However, Habas and Macdonald found that DIT from solid meals was higher than DIT from liquid meals. They suggested that other factors such as hormonal response and osmolarity of the meal may influence gastric-emptying rates, which in turn would influence the metabolic response to the meal.

A somewhat surprising result from the current study was an interaction between meal form and exercise group. The resistance-trained group had a significantly increased DIT after shake consumption compared with the bars. Endurance-trained and sedentary individuals did not have any alterations between bar and shake consumption in terms of their change in energy expenditure. Even more interesting was that after correcting for FFM the difference between shakes and bars in the resistance group was still evident; there was also a meal-form and group interaction in the sedentary group. After correcting for FFM, the sedentary group had a lower DIT response with shake consumption than with bars. This suggests that resistance training evokes a change in metabolic behavior that increases energy
expenditure from liquid meals. Thyfault et al. (2004) found that DIT was increased in resistance-trained individuals after they consumed a high-carbohydrate meal (79% of calories from carbohydrate). However, because the macronutrient distribution of the meals in the current study was similar between both meal forms and neither contained more than 46% of calories from carbohydrate, the current study’s difference in DIT response was likely not caused by high carbohydrate content or alterations in the composition of the meal. Conversely, the macronutrient distributions of the bars and shakes in the current study were only similar, not identical, so it is possible that the difference in DIT response was indeed caused by alterations in meal composition. Research has yet to indicate specifically how small a difference in macronutrient content can change DIT. The reason for this interaction between meal form and exercise group is not clear from this study; however, it may be interesting to speculate that resistance training alters release of hormones such as incretins in the gut, which could affect gastric-emptying rates or energy utilization (Schirra et al., 1996). It may also be interesting to suggest that the resistance-training group demonstrated increased DIT after consuming the shake (liquid) because they regularly consume a postexercise shake or liquid-meal supplement.

Although some of the DIT-related findings of the current study may have substantial impact on our understanding of habitual exercise’s relationship with gastric emptying, the study period of DIT measurements (3.5 hr after meal) by no means represents the completion of DIT. Metabolic rate at 3.5 hr remained elevated above baseline, and, therefore, a truly complete analysis of DIT is not fully captured in 3.5 hr. The complete value of DIT may reveal a different scenario than what is presented here. Nonetheless, this period of time (3.5 hr), based on many previous studies (Belko et al., 1986; Denzer & Young, 2003; LeBlanc et al., 1984; Poehlman, Melby, & Badylyak, 1988), does lend itself to providing a stronger idea of DIT than was previously known.

Another major limitation of this study is the low number of subjects in each of the experimental groups. Weststrate (1993) showed that experiments involving fewer than 10 subjects per group have lower power because of the inherently high variability of DIT measurements. This variability occurs within individual subjects, as well as within experimental groups. Possible reasons for the high variability in DIT measurements may be day-to-day differences in the diet’s macronutrient composition, postprandial nutrient metabolism, or other factors (Weststrate, 1993). The interindividual CV for subjects in this study was high, but this is consistent with Weststrate’s findings. The fact that the CV for DIT between the subjects in the experimental groups was similar provides more confidence in the statistical difference seen in DIT with the different meal forms in the sedentary and resistance-trained groups. This study’s sample size (n = 29; groups were n = 9, 11, and 9, respectively) compares favorably with that of other studies (Denzer & Young, 2003; LeBlanc et al., 1984; Poehlman, Melby, & Badylyak 1988).

The current study examined the three significant components of energy expenditure in college-age men, and it was determined that resting metabolic rate, not DIT, was significantly greater in groups of habitual exercisers. In addition, we speculate that the DIT response from a solid or liquid meal is altered depending on the exercise-training status of an individual. These results give further support to the importance of frequent exercise in amplifying the body’s total energy expenditure.

Acknowledgments

This study was supported by internal funds from Auburn University (K.W.H.) and Alabama Agricultural Experiment Station #013-020 (S.S.G.).

References


