

# The Effect of Meal Frequency on Preprandial Resting Metabolic Rate

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## ABSTRACT

Many nutrition and exercise professionals recommend eating five to six small meals throughout the day to maximize metabolism for weight loss. However, research supporting this claim is limited. The purpose of this study was to determine if a significant relationship existed between preprandial (before eating) resting metabolic rate (RMR) and meal frequency or eating sessions in healthy adult females. Twenty-two women ages 18 to 74 ( $M=30$ ,  $SD=15$ ) volunteered as participants. Each woman kept a detailed diet diary for seven days. At the end of seven days each woman had her preprandial RMR measured by using indirect calorimetry. Results indicated no significant relationships between RMR or METS and mean daily energy intake frequencies. The results also revealed no significant relationship between RMR and eating sessions. Limitations are discussed.

## INTRODUCTION

Many nutrition and exercise professionals recommend eating five to six small meals of approximately equal caloric amounts throughout the day to maximize an individual's metabolic rate. It has been theorized that a long period of time between meals slows one's metabolism by simulating starvation. In an attempt to conserve energy, metabolism slows causing the body to burn fewer calories throughout the day, whether at rest or during activity. There has been limited research defending this theory. The Department of Nutrition and Dietetics of King's College London reported that energy use is lower with fewer meals. However, no major impact was found on metabolic rate. Animals have been used to conduct studies to evaluate the effect of meal frequency on metabolic rate (Ernahrungswiss, 1997). However, it may be inappropriate to extrapolate the results suggested from animal research and compare it to humans. Other research has been conducted without finding significant results to support the hypothesis that greater meal frequencies will increase the metabolic rate (Bellisle, McDevitt, & Prentice, 1997). Hence, the objective of our study was to determine if a relationship between meal frequency and/or feeding (meals plus snacks) and a preprandial RMR exists. Based on theory, we expect participants who report a high frequency of eating sessions to have a significantly higher preprandial resting metabolic rate. If this hypothesis is supported, the information could be used to help individuals achieve weight loss or weight management.

## METHOD

### Participants

Twenty-two females between the ages of 18 and 74 ( $M=30$ ,  $SD=15$ ) volunteered for the study. All of the females had to meet specific criteria to be a participant. The criteria were based on variables that could have affected metabolism. Participants were not to have exercised in the previous three months. They were not to have any known metabolic disorders. They were not to be taking any medications or dietary supplements that could potentially affect metabolism. Lastly, participants were not to be pregnant or lactating. See Table 1.

**Table 1.** Participant Demographics

	Minimum	Maximum	Mean	SD
Age (Years)	18	74	30	15
Height (Cm)	155	175	163	5
Mass (Kg)	50	104	65	13

## MATERIALS

A diet diary designed by the researchers was distributed to each participant to report her food intake for seven days. In this diet diary they recorded all food ingested, time of day food was eaten and approximate amounts of food eaten. The Quinton QMC metabolic cart was used to assess resting metabolic rate of the participants. NutraQuest™ (Mc Graw Hill Inc.), a nutritional software program, was used to analyze the participant's caloric intake.

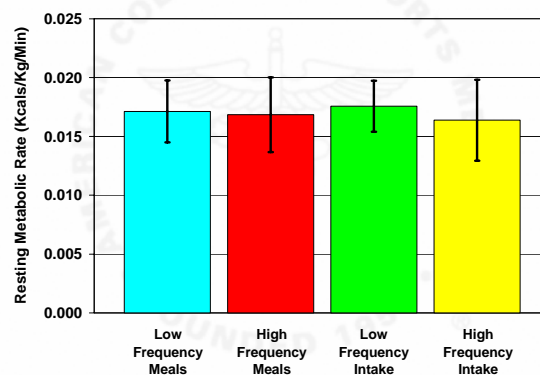
### Procedure

Participants were accepted on a rolling basis. When an individual committed to participate in the study, she scheduled a time for an orientation session. At the orientation session, each participant signed an informed consent form. She was then given specific instructions on the desired method to record what and how much she ate in the diet diary. At this time, the participant was also debriefed on how the procedure for obtaining resting metabolic rate would be conducted. At the end of seven days the diet diary was turned into the research team. In addition, a preprandial RMR test was conducted in the University of Wisconsin-La Crosse Human Performance Lab. Prior to testing, participants were to minimize their physical exertion and to have fasted for at least six hours. The Quinton QMC metabolic cart was calibrated and then the mouthpiece was attached to the participant. She was then instructed to lie in the supine position on a padded table. Resting metabolic rate was measured by indirect calorimetry. The test was performed for 20 minutes; however, only data from the last five minutes was utilized in the study. Diet diaries were analyzed using NutraQuest™ nutritional software (Mc Graw Hill Inc.).

## RESULTS

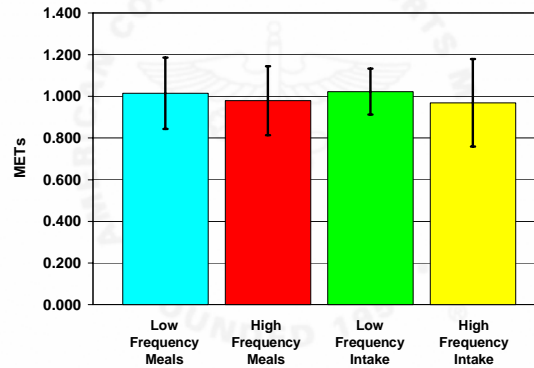
Average meal frequency (AMF) was calculated by averaging each participant's total meals a day. This number was then averaged across participants to yield an overall AMF of 2.7 meals a day. Participants who reported an average daily meal frequency (ADMF) of greater than 2.7 were categorized into the high meal frequency (HMF) group. Participants who reported an ADMF of less than 2.7 were categorized into the low meal frequency (LMF) group. An eating session was defined as anytime during the day a participant consumed any amount of food. For each participant, an average daily eating session (ADES) was calculated by adding up the total eating sessions in the seven day period and dividing by seven. The overall ADES was calculated by averaging all of the participants' ADES, which yielded 4.7 daily eating sessions. Those participants who reported an average greater than 4.7 eating sessions were categorized in the high eating sessions group (HES). Those participants who reported an average lower than 4.7 eating sessions were categorized in the low eating sessions group (LES). Analysis of Covariance (ANCOVA) was used to detect a relationship between HMF or LMF and RMR and also between HES or LES and RMR. Average daily caloric intake and age were used as covariants to determine any effects on RMR. Alpha level was set at .05.

Results of ANCOVA revealed no significant relationship between HMF and RMR and also between LMF and RMR ( $F=0.001$ ,  $p=0.981$ ). Also the results of the ANCOVA revealed no significant relationship between LES and RMR as well as HES and RMR ( $F=0.601$ ,  $p=0.450$ ). See Figure 1.



**Figure 1.** Resting metabolic rate and eating frequency. Error bars show standard deviations.

Results of the ANCOVA revealed no significant differences in METS between HMF and LMF as well as HES and LES. See Figure 2.



**Figure 2.** MET levels and eating frequency. Error bars show standard deviations.

## DISCUSSION

The results of the present study fail to support the hypothesis that participants with high daily meal frequency have significantly higher resting metabolic rates as compared to participants with a low daily meal frequency. Meal frequency does not appear to effect metabolic rate. Our study coincides with similar research that has studied the effect of meal frequency and RMR. A similar study found no significant difference in total daily thematic effect of food among frequent and infrequent feeders on isocaloric diets (Kinabo, & Durnin, 1990). Other studies pertaining to RMR and meal frequency of frequent and infrequent eaters have not shown differences in RMRs of healthy (Garrow, Durrant, Mann, Stalley, & Warwick, 1978; Taylor & Garrow, 2001), diabetic (Arnold, Mann, & Ball, 1997), and hyperlipidemic individuals (Arnold, Ball, & Mann, 1994). Despite the inability to find an association between meal frequency and resting metabolic rate, it may still be beneficial for nutrition and fitness professionals to continue to recommend eating small meals throughout the day for weight management purposes. Smaller meals throughout the day may prevent an individual from gorging, thus overeating, during the day, which could ultimately impact body mass favorably.

## LIMITATIONS

For future research it is necessary to establish specific criteria regarding meals and snacks that were omitted in this study. A pre-determined amount of calories or percentage of total calories consumed by the participant in a day should be used to differentiate between a meal consumption and snack consumption. For example, calories greater than 500 consumed in one sitting could be predetermined as a meal and anything less than 500 calories in one sitting could be a snack. Having either pre-determined caloric amounts or percentages to determine a meal or snack would allow for easier classification. Data may be more accurately reported if each participant is given a dietetic scale to measure her serving size. This will allow the participants to precisely record the amounts of food they consume eliminating much of the participant variability.

A different software program to calculate caloric amounts of meals and snacks should be considered for future research of this topic. NutraQuest<sup>™</sup> nutritional software (Mc Graw Hill Inc.), the software program used, did not offer a diverse selection of foods to choose from. Due to this, substitutes were chosen for food items not listed in the NutraQuest<sup>™</sup> nutritional software (Mc Graw Hill Inc.) program.

One last issue to keep in mind when conducting future research is the role of menstruation on metabolic rate. If menstruation does affect the metabolic rate, it is possible that the data collected could have been affected. In this study menstruation was not evaluated as a factor that could influence metabolic rate.

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