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Appropriately Balance Energy Intake and Output in and
out of Season?

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COMPENSATION THEORY: CAN CLUB SOCCER PLAYERS APPROPRIATELY
BALANCE ENERGY INTAKE AND OUTPUT IN AND OUT OF SEASON?

by

MARCO RUGGIERO

(Under the Direction of Dr. Bridget Melton)

ABSTRACT

Obesity is a worldwide epidemic affecting both adults and children. Obesity and overweight prevalence is increasing, with a corresponding decline in physical fitness and general physical activity level (McHugh, 2010). The college setting presents an important opportunity for health promotion during a critical developmental stage for weight gain (Nelson et al., 2007). While exercising and a balanced diet are the basis of most obesity-prevention campaigns, little research has been done on how physical exercise may increase food consumption. The purpose of this study was to examine whether college club soccer players can appropriately balance energy intake and output in and out of season. A convenience sample of twenty-four college students (14 males and 10 females), at a midsized southeastern university between the ages of 18 and 23 years participated in the study. Self-reported anthropometrics and three-day food logs were obtained. Participants were given accelerometers to be worn under clothes on right side of hip for seven days. Food logs and accelerometers were analyzed one time during season and one month post season to receive normal training week and normal out of season readings for food consumption and activity levels. The average calories consumed increased from 1885 kcal/day in season to 1937 kcal/day out of season. The average calories burned decreased from 479.39 kcal/day in season to 451.46 out of season. There were no significant differences for physical activity besides a significant decrease in Total Vigorous Time in minutes. Coaches and dietitians

need to encourage and educate athletes on healthier food choices and knowledge on energy balance, so during the off season athletes do not hinder their performance by being out of shape or overweight. More studies are needed to examine compensatory effects with different populations with both starting and ending exercise programs.

INDEX WORDS: Compensation, Obesity, College, Physical activity, Energy balance

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B.S., Berry College, 2010

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DEDICATION

I would like to dedicate my thesis to my wonderful family, friends, and girlfriend. Throughout this process, they have been my biggest supporters. They have provided me with the strength and encouragement to make this all possible. I am so very thankful and blessed to have such a great support group behind me during this process and chapter of my life.

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CHAPTER 1

INTRODUCTION

Compensation Theory: Can club soccer players appropriately balance energy intake and output in and out of season?

Obesity is a worldwide epidemic affecting both adults and children. Obesity and overweight prevalence is increasing, with a corresponding decline in physical fitness and general physical activity level (McHugh, 2010). Obesity is a major health hazard worldwide and is associated with several relatively common diseases such as Type 2 diabetes, hypertension, heart disease, and some cancers (CDC, 2011). Overweight and obesity result from an energy imbalance (CDC, 2011). This involves eating too many calories and not getting enough physical activity (CDC, 2011). Given that energy intake and activity energy expenditure are two major determinants of body weight, their independent and combined compensatory responses could undermine the exercise-induced energy expenditure (King et al., 2008). Although changes in energy balance produce weight changes, the extent of these changes varies from individual to individual (Chanmugam et al., 2003).

The college setting presents an important opportunity for health promotion during a critical developmental stage for weight gain (Nelson et al., 2007). A recent study by Nelson and colleagues was the first to examine prevalence, trends and social disparities in overweight, obesity and class II obesity in a nationally representative sample of college students in the United States (Nelson et al., 2007). The research and data were derived from a sample of 24,613 students younger than 25 years of age surveyed from two time periods 1993 and 1999 (Nelson et al., 2007). Results showed a prevalence of overweight among the students, which increased between

the two study periods (Nelson et al., 2007). Males were more likely to be overweight and obese than females, but no difference existed in class II obesity rates with gender (Nelson et al., 2007). Students were more likely to be overweight or obese in their later years of college (Nelson et al., 2007).

Obesity continues to be a major issue among United States with seventy percent of adults being overweight and now obesity is occurring in athletes (Mathews & Wagner, 2008). Although, college students have been highlighted as a high need group, athletes in particular might lead to information on why they are becoming overweight. Mathews and Wagner (2008) assessed that high school, collegiate, and professional football players have gradually increased in size over the past several decades. In a recent study of 3,600 high school linemen, authors found, that forty five percent were overweight when national average of adolescents are sixteen percent and nine percent were severely obese (Mathews & Wagner, 2008). It is important to remember that although BMI correlates with the amount of body fat, BMI does not directly measure body fat (Mathews & Wagner, 2008). These risks grow even higher once these athletes stop playing (Peterson & Fox, 2007). When these athletes become sedentary after high school and are still consuming the same amount of food, health issues are a major concern (Peterson & Fox, 2007).

Poppitt and Swann (1998) sought to analyze the optimization of diet with physical activity, as well as the efficacy of compensation or manipulation of diet due to physical exercise. Wansink (2007) explained that compensation is due to a subconscious reward theory, which suggests that when physical or mental effort is spent on exercising, one rewards by eating more (Wansink, 2007). The mental aspect demonstrates that exercise does not have to be performed to lead to compensation. There are many lifestyle behaviors that influence whether or not a person

can maintain energy balance, such as, eating processed foods, over whole grains, fruits, and vegetables (Ello-Martin, Ledikwe, Rolls, 2005). The compensation theory suggests that people are convinced at a subconscious level that engaging in healthy activities neutralizes subsequent indulgent behavior (Wansink, 2007). While exercising and a balanced diet are the basis of most obesity-prevention campaigns, little research has been done on how physical exercise may increase food consumption.

Many investigators have studied the dietary habits of soccer players in an attempt to examine whether the reported diets fulfill dietary recommendations and balance their energy (Burke, 2001, Costas et al., 2012, Ruiz et al, 2005). The vast majority of these studies have examined players at elite, Olympic, or professional level (Costas et al., 2012). A large number of players, however, compete at a semi-professional level that is usually a pool from which not elite but professional clubs choose their members to form their squads (Clark et al., 2003; Scott, Chisnall, Todd, 2003; Costas et al., 2012). In Greece for example, semi-professional soccer players account for more than 10 % of the total number of soccer players who compete at all levels (professional, semi-professional, amateur), whereas professionals do not represent more than 4 % (Costas et al., 2012). Few studies have examined the dietary habits of lower level soccer players (Ruiz et al., 2005).

A quality nutritional regimen is essential to athletic success by improving the quality of training, maximizing performance and recovery time (Martin, Lambeth, Scott, 2006). Soccer is described as a high intensity intermittent sport involving continual changes in activity (Hargreaves, 1994). Such high metabolic and energy demands of soccer training and competition must be met by adequate nutritional intake (Martin, Lambeth, Scott, 2006). Previous research on the nutritional practices of female soccer players is limited but has reported daily energy intakes

ranging from 1778 to 2290 kcal•day⁻¹ (Clark et al., 2003; Scott, Chisnall, Todd, 2003) with percentage carbohydrate, protein and fat intakes of 47.8, 13.9 to 15.0 and 29.0 to 33.3 respectively (Clark et al., 2003; Scott, Chisnall, Todd, 2003). It is recognized that much of the dietary data on adolescents and athletes is prone to reporting error, mostly through under-reporting (Magkos & Yannakoulia, 2003; Livingstone, Robson, Wallace, 2004). The few studies assessing the nutritional intake of young soccer players adopted different methodologies and the majority of them reported sub-optimal average energy intakes (Costas et al., 2009). Nevertheless, intakes have often been reported as if valid and under-reporting has not been taken into consideration.

A better understanding of how energy balance is regulated, biological, behavioral, and environmental factors have to be taken in consideration to affect energy balance and body weight regulation will help in developing effective strategies for the prevention and treatment of obesity (Hill et al., 2006). A variety of factors contribute to obesity including: high dietary fat intake, physical inactivity and overconsumption of energy (Chanmugam et al., 2003). In general, energy intakes have increased 200 to 300 kcal/day over the last two decades (Chanmugam et al., 2003). One of the greatest problems in making predictions of energy needs centers around estimations of energy expenditure (Chanmugam et al., 2003). Compensatory reductions in energy expenditure could also oppose any perturbations in energy balance. Compensatory adjustments in exercise and non-exercise activity, and a reduction in physical activity in the non-exercise time, could contribute to a lower than predicted weight loss (Donnelly et al, 2003).

Quality nutrition can improve exercise performance, decrease recovery time from strenuous exercise, prevent exercise injuries due to fatigue, provide the fluid and fuel required

during times of high-intensity training, and help maintain an appropriate body weight and composition for one's sport (Burke, 2001). Health and nutrition professionals recommend that 55-60% of the calories in athletes' diet come from carbohydrate, no more than 30% from fat and the remaining 10-15% from protein (Manore, Meyer, Thompson, 2009). Optimal energy, fluid, and nutrient intakes also help keep athletes healthy, which in return help them perform at their best in training and competition (Manore, Meyer, Thompson, 2009). Soccer has received much attention in recent years regarding activity patterns of the game as well as its metabolic demands during training and competition (Chrysanthopoulos et. al., 2009). Soccer training and competition result in increased energy and protein requirements that must be accompanied by increased energy intake for sustained performance (Caccialanza, Cameletti, Cavallaro, 2007).

The few studies that have investigated compensatory theory have focused the changes that occur when sedentary individuals become active with a structured exercise program (King et. al, 2008; Wansink, 2010). Currently there is not any research that looks at when an individual in structured exercise programs end or reduced their physical activity levels. Additionally, previous studies have focused on physical activity patterns only and not dietary recalls (Odgen et al., 2006; Whaley, Brubaker, Williams, 2006; Rangan et al., 2011). Therefore, reaching a clear understanding of the relationship between physical activity and food intake may prove valuable in understanding an individual's energy balance.

Problem Statement

The aim of this study is to examine if college age club soccer players can appropriately balance energy intake and output in and out of season.

Rationale

Most of the focus in compensatory research has been on individuals, who begin an exercise program; little research has focus on what happens to individuals who stop an exercise program (King et. al, 2008; Wansink, 2010; Rangan et. al., 2011). This current study hopes to reveal what happens when consistent physical activity ends. This knowledge may better educate coaches and exercise professionals on how to consult athletes on terminating exercise program so their athlete will be able to balance the energy intake appropriately to ultimately avoid excess weight gain.

Each of the participants will benefit from this study by gaining a better understanding of their own energy balance. Commonly, female athletes in-season have a negative energy balance, which results in a body mass loss and negative effects on performance outcomes' and out-of-season they commonly have a positive weight gain, which have a negative impact on body image (Martin, Lambeth, Scott, 2006). The participants will better understand if they are properly balancing their energy intake and output both in and out.

CHAPTER 2

METHODS

This study was a quasi-experimental design with pre and post tests.

Participants

A non-randomized convenient sample of 24 collegiate club soccer players from a midsized southeastern university ranging in ages from 18-23 were recruited for this study. Prior to data collection, each participant was informed on the purpose and requirement for the study. Institutional Review Board approval was gained prior to data collection. Players are members of a club team during fall/spring 2011-2012 season. The length of the season lasted from

September-March. The participants trained at least three times per week for about 90 min during season.

Instrumentation

3-Day Dietary Recall

Dietary intake was assessed using a 3-day food record, this method of assessment has been found to be a consistent and valid (Crawford et al., 1994). The players were requested to record all food items and beverages consumed for three normal days for each data collection. The food logs will then be recorded into myfitnesspal.com to assess calories and macronutrients. Myfitnesspal is a food journal database that allows individuals to track food and activity by providing the tools to easily input them in and easily calculates diet and activity (Myfitnesspal LLC, 2012).

Accelerometer

Physical activity was assessed using a seven day physical activity measure using an accelerometer device. Accelerometers have been found to be valid and reliable instruments to estimate energy expenditure from physical activity (Wixted, 2007). An accelerometer uses an electric lever to detect accelerations in the vertical plane in the range of 0.05-2g (Rothney et al., 2008). The range is consistent with normal human movement and allows the rejection of high intensity vibrations (Rothney et al. 2008). Flexion of this lever cause by movement generates a signal proportional to the amount of acceleration (Rothney et al., 2008). The signal is then summed over a user defined time period (epoch), which may range from 1-240 seconds; an epoch of 60 seconds was set for this study. An accelerometer is small, lightweight and has been demonstrated to measure physical activity in children reliably when compared with indirect and

room calorimetry, and doubly labeled water techniques (Schmitz et.al, 2005). Data can be downloaded immediately following completion of the protocol using the Actigraph software version 3.8.3 (Actigraph, LLC., 2011).

Procedures

Prior to commencement of data collection, participants had the study procedures explained, any questions were answered that time, and informed consent was obtained. To assess energy intake at pre- and post –test, participants completed 3-day diet records at home, which the 3-day record had the strongest agreement between observed and reported intakes (Crawford et al., 1994). Data was collected during two periods: in-season and one month post season measures for participants. At each data collection meeting, the participants was given an accelerometer and will administered the three-day dietary recall.

To assess physical activity (PA), subjects were instructed to wear Actigraph accelerometers (model GT3X, Pensacola, FL) for seven days, except during water-based activities or when sleeping (Ward et. al., 2005).The categories that physical activity that was analyzed was total time in minutes of sedentary, light, lifestyle, moderate, vigorous and very vigorous. Self-reported by participants were height and weight to enter data with the Actigraph software to determine energy expenditure. The Actigraph accelerometer is a reliable instrument, with an intraclass correlation of 0.99 (Esliger & Tremblay, 2006).

Data Analysis

Statistical analyses were conducted using IBM SPSS Statistics 19. Independent T-Tests was used to examine differences in energy balance, physical activity, and macronutrient intakes throughout the recording period. (V19, SPSS Inc. Chicago, IL, USA).

CHAPTER 3

RESULTS

Subject Characteristics

The demographics of the participants are depicted in Table 1 and are individualized by In Season and Out of Season. Twenty-four athletes initially began the study. However, two students did not come back for their out of season measure. Therefore, only twenty-two completed the out of season measurement. Of the twenty-four participants in season of the study, there were 14 (58.3%) male and 10 (41.6%) female. Of the twenty-two participants out of season part of the study, there were 13 (59.1%) male and 9 (40.9%). Of the twenty-four participants in season of the study, their ages five were 18 (20.8%), four were 19 (16.7%), nine were 20 (37.5%), four were 21 (16.7%), one were 22 (4.2%), and one were 23 (4.2%). Of the twenty-two participants out of season of the study, their age six were 18 (27.3%), eight were 19 (36.4%), five were 20 (22.7%), two were 21 (9.1%), and one were 22 (4.5%). Finally, based on CDC 's BMI cut points there were 0 underweight (less than 18.50), 15 normal weight (18.5-24.99), nine of overweight (25.00-29.99) and zero obese (greater than 30.00) participants in season of the study (CDC, 2011). There were zero underweight (less than 18.50), 14 normal weight (18.5-24.99), six of overweight (25.00-29.99) and two obese (greater than 30.00) participants in out of season of the study.

Table 1

Frequencies and percentiles of demographic characteristics of participants (N=46).

Variable	N	(%)	N	(%)

In Season (n=24)			Out Season (n=22)		
Gender			Gender		
Male	14	58.3	Male	13	59.1
Female	10	41.7	Female	9	40.9
Age			Age		
18	5	20.8	18	6	27.3
19	4	16.7	19	8	36.4
20	9	37.5	20	5	22.7
21	4	16.7	21	2	9.1
22	1	4.2	22	1	4.5
23	1	4.2	23	0	0
BMI Classification			BMI Classification		
Underweight	0	0	Underweight	0	0
Normal	15	79.2	Normal	14	63.6
Overweight	9	20.8	Overweight	6	27.3
Obese	0	0	Obese	2	9.1

Statistical Significance

Statistical significance in and out of season of club athletes determined by independent t-tests is depicted in Table 2. The variables demonstrated in this table were calories, carbohydrates, fat, proteins, avg. kcal burned, total time sedentary, light, lifestyle, moderate, vigorous, and very vigorous activity. Depicted by the asterisk, only Total Vigorous was found to be significantly difference between in and out of season ($p=0.001$, $t=3.502$.)

Table 2

Statistical Significance of Between In Season and Out of Season of Club Athletes Determined by Independent T-Tests

Variable	Degrees of Freedom	Mean Dif.	t=score	Significance
Calories	44	-51.219	-0.347	0.884
Carb.	44	-14.906	-0.653	0.933

Fat	44	-12.510	-1.394	0.468
Protein	44	4.841	0.565	0.261
Avg. kcal burned	44	-27.933	0.424	0.959
Total Sedentary	44	82.992	0.231	0.367
Total Light	44	131.220	1.209	0.905
Total Lifestyle	44	18.254	0.425	0.555
Total Moderate	44	24.307	0.463	0.816
Total Vigorous	44	27.943	3.502	0.001*
Total Very Vigorous	44	0.500	0.398	0.698

* $p \leq 0.05$

Energy Balance

Overall means of energy balance of the effects of in season and out of season Club soccer players is depicted in Table 3. The average of the soccer players in season was 1885 calories and increased to 1937 calories out of season. Average calories burned daily went from 479.39 in season and decreased to 451.46 out of season. Table 3 further examines calories into macronutrients where Carbohydrates, Fats, and Proteins are assessed in grams and increases and decreases from in season and out of season are shown. Carbohydrates went from 232.12 g in season and increase to 238.02 g out of season. Fat went from 61.66 g in season and increases to 74.17 g out of season. Protein went from 82.85 g in season and decreases to 78.01 g out of season. Energy output was categorized as Total Time Sedentary, Light, Lifestyle, Moderate, Vigorous, and Very Vigorous in minutes. Total Time Sedentary went from 3530.59 minutes in season to 3588.03 minutes out of season. Total Light went from 1041.08 minutes in season to 909.86 minutes out of season. Total Lifestyle went from 381.71 minutes in season to 363.45 minutes out of season. Total Moderate went form 385.13 minutes in season to 360.82 minutes out of season. Total Vigorous went from 39.63 minutes in season to 11.68 minutes out of season. Total Very Vigorous went from 2.00 minutes in season to 1.50 minutes out of season.

Table 3

Report of overall means of energy balance on the effects of in season and out of season Club soccer players

Demographic Variable	n.	Mean	Standard Error
Calories In			
In Season	24	1885	102.78
Out Season	22	1937	106.07
Kcal Burned			
In Season	24	479.39	43.70
Out Season	22	451.46	49.59
Carbs (g)			
In Season	24	223.12	15.14
Out Season	22	238.02	17.17
Fat (g)			
In Season	24	61.66	5.53
Out Season	22	74.17	7.18
Protein (g)			
In Season	24	82.85	6.72
Out Season	22	78.01	5.12
Total Sedentary (min)			
In Season	24	3530.58	275.05
Out Season	22	3588.03	224.90
Total Light (min)			
In Season	24	1041.08	73.39
Out Season	22	909.86	80.23
Total Lifestyle (min)			
In Season	24	381.71	30.80
Out Season	22	363.45	29.76
Total Moderate (min)			
In Season	24	385.13	35.61
Out Season	22	360.82	38.64
Total Vigorous (min)			
In Season	24	39.63	7.33
Out Season	22	11.68	3.15
Total Very Vigorous (min)			
In Season	24	2.00	1.04
Out Season	22	1.50	0.66

New data from this study demonstrates a trend with less calories being burned through physical activity and there is either the same or even an increase in caloric consumption. There are increases from carbohydrates and fat, and a decrease in protein. The decrease of protein can be considered due to the lower energy expenditure.

CHAPTER 4

DISCUSSION AND CONCLUSION

Investigated in this study was the nutrient intakes and physical activity of collegiate club soccer players using a 3-day food records from two time points, and estimated energy expenditure during the same period with accelerometers.

Energy Balance

Knowledge of an athlete's energy intake and energy expenditure during physical activity is necessary to properly plan specific diets for individual athletes (Whaley, Brubaker, Williams, 2006; Burke, 2001). Results of this study found an average of $1,885 \pm 103$ kcal in season and $1,937 \pm 106$ calories out of season in club soccer players. Studies on elite soccer players show that the energy intake is likely to be 2033 - 4000 kcal per day, although this depends on factors such as intensive training where intake may need to be increased or periods of inactivity such as injury where the player should reduce intake (Martin, Lambeth, Scott, 2006; Caccialanza, Cameletti, Cavallaro, 2007; Costas et al., 2009). The mean reported daily energy intake was slightly lower than the mean daily energy intake reported by Ruiz et al. (2005). Variations in energy intake are likely to lead to weight loss or gain. From this study's participants two went from overweight to obese in just one month out of season. Players can evaluate their energy balance through recording their own weight. Any changes in weight may indicate a diet that is either lacking or too excessive. However, players can positively gain some weight due to

increased muscle mass from weight training and an examination of body composition (such as skinfold measurements) may be a better indicator of body weight (Manore, Meyer, Thompson, 2009). Players may also weigh and record all the food and drink they consume and food labels supply valuable information on what food contains. Although this is tedious, it can provide an idea on energy intake and the composition of the food they eat

Macro-nutrients

Carbohydrate is the primary fuel substrate during soccer, and should have high dietary intakes of 60-70% of total caloric intake have been recommended for athletes (Whaley, Brubaker, Williams, 2006). In the present study, carbohydrate intake was significantly lower than these recommendations ($47.3 \pm 6.8\%$), but fall within the range previously reported for female soccer players 47.8 ± 9.8 to $55.0 \pm 7.5\%$ (Martin, Lambeth, Scott, 2006). Participants could increase carbohydrates by switching their reported high fat foods with carbohydrates, which consequently, would not harm energy balance because carbohydrates are less calories per gram than fat.

Physical Activity

There is growing interest in research over the effects of exercise programs on nonexercise activity levels. Data from the National College Youth Risk Behavior Survey analyzed 4,609 undergraduate college students (Lowry et al., 2000). Only 19.5% of students reported participating in moderate activity for five or more days per week. In this study there were lower levels of activity in every category analyzed (Sedentary, Light, Lifestyle, Moderate, Vigorous, and Very Vigorous) in off season. This study demonstrated activity levels from one month of off season training. Rangan (2011) ran analysis that suggested that when the exercise training is of

sufficient duration, no activity compensation occurs. When participants are allowed to reach a new steady-state level of physical activity, they adjust to the effects of regular exercise training (Rangan et al., 2011). These findings can affect energy expenditure and activity levels providing athletes to become eating more without exercising more. This study suggests more caloric intake during off season with less energy expenditure providing activity is decreases while food consumption is increasing.

In the sporting context again, in more dynamic or team sports, utilizing accelerometers, as a diagnostic tool in athletics, is something many teams could incorporate into regular training sessions to assess the agility and balance. The implementation of accelerometers in this manner would not only give comparative measures between athletes but also produce a baseline measurement to use in energy balance, if the need ever arose.

Limitations

Methods used for measuring food intake rely on the participants' ability to accurately record 'what' and 'how much' is eaten. Unfortunately, self-reported dietary intake protocols are frequently biased towards underestimation of dietary intakes (Caccialanza, Cameletti, Cavallaro, 2007), which may explain the discrepancy between energy intake observed in the present study. A potential limitation to this study is the fact that accelerometry is not a perfect measure of physical activity, because it is worn on the hip and does not accurately detect bicycling or upper body movement, such as weight lifting (Ward et. al., 2005). Similarly, the accelerometer cannot be worn during water-based activities, such as swimming.

Conclusion

Despite limitations of the self-reporting techniques used, dietary intakes of club soccer players in the present study are lower than recommendations of ACSM. The participants are low

in carbohydrates and protein and are high in fat. Thirty five percent of the participants' diet is coming from fat in season and out of season. The participants increased average caloric intake from in season to out of season by 52 calories. Also, the participants ended up burning an average of 28 calories less in off season. These findings are very interesting that these individuals are actually eating more and being less active in the off season of their sport. Important attention must be made to diet during moments of inactivity, when changing eating habits and attempting to lose weight. Exercise is a good means of reducing body weight as well as keeping players in shape, especially when players are inactive. This is not only valuable information for the participants but also coaches and nutrition consultants. Coaches and consulting need to encourage and education athletes on healthier food choices and knowledge of energy balance, so, in the off season participants do not hinder their performance by being out of shape or overweight. It is always advisable for players to consult experts such as a doctor or sports nutritionist when changing dietary habits. Future research should consider improving the accuracy of self-reporting techniques in athlete populations by providing more training on portion sizes and encourage the importance of healthy food choices and physical activity regimen.

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In professional soccer, the average work load during a soccer match is estimated from variables such as heart rate, which is approximately 70% of maximal oxygen uptake (VO₂ max). This corresponds to an energy expenditure of 1500 kcal of an average player weighing 75 kgs. Aerobic energy production appears to account for more than 90% of total energy consumption. Nevertheless, anaerobic energy production plays an essential role during soccer matches. During vigorous exercise periods of a game, creatine phosphate, and to a lesser extent the stored adenosine triphosphate, are utilized. Both compounds are partly restored during a subsequent prolonged rest period. Thus, the anaerobic energy systems are heavily taxed during periods of match-play. However, all substrates are used in a soccer matches which taxes on anaerobic and aerobic pathways, thus, causing oxidative metabolism in the muscles.

Caccialanza, R., Cameletti, B., and Cavallaro, G. (2007). Nutritional intake of young

Italian high-level soccer players: Under-reporting is the essential outcome. *Journal of Sports Science and Medicine*, 6, 538-542.

It is recognized that much of the dietary data on adolescents and athletes is prone to reporting error, mostly because the adolescents and athletes are in fact underreporting. Nevertheless, in the majority of studies assessing the nutritional intake of young soccer players under-reporting has not been taken into consideration. , in order to reduce the degree of under-reporting, In order to obtain reliable data on the dietary intake of young soccer players there needs to have a way to evaluate the efficacy of targeted nutrition education programs.

Centers for Disease Control and Prevention. Division of Nutrition, Physical Activity, and Obesity. 2011

Centers for Disease Control (CDC) criteria have been used to categorize children as overweight and at risk of overweight based on body mass index (BMI) (CDC, 2011). Obesity is a major health hazard worldwide and is associated with several relatively common diseases such as diabetes, hypertension, heart disease, and some cancers (CDC, 2011). Overweight and obesity result from an

energy imbalance (CDC, 2011). This involves eating too many calories and not getting enough physical activity (CDC, 2011). Behavior and environment play a large role causing people to be overweight and obese (CDC, 2011).

Cloud, J. (2009). Why exercise won't make you thin. *Time*, 1-8.

Cloud writes in his article that the basic problem is that while it's true that exercise burns calories and that you must burn calories to lose weight, exercise has another effect: it can stimulate hunger. Exercise causes us to eat more, which in turn can negate the weight-loss benefits we just accrued. Exercise, in other words, isn't necessarily helping us lose weight. It may even be making it harder. Church's team randomly assigned into four groups 464 overweight women who didn't regularly exercise. Women in three of the groups were asked to work out with a personal trainer for 72 min., 136 min., and 194 min. per week, respectively, for six months. Women in the fourth cluster, the control group, were told to maintain their usual physical-activity routines. All the women were asked not to change their dietary habits and to fill out monthly medical-symptom questionnaires. The finding from this study were all groups ended up losing weight but the group that had the personal trainer did not lose a significantly more than the control group.

Costas, C., Kostas, K., Maira, M., and Anatoli, P. (2009). Nutritional intake of semi-professional soccer players during a week in the competitive season. *Serbian Journal of Sports Science*, 1, 1452-1455.

Recent advancements in technology have allowed more accurate measurements in the field and in the laboratory regarding the activity pattern of the game as well as its physiological and metabolic demands during training and competition. A large number of players, however, compete at a semi-professional level that is usually a pool from which not elite but professional clubs choose their members to form their squads. In Greece for example, semi-professional soccer players account for more than 10 % of the total number of soccer players who compete at all levels (professional, semi-professional, amateur), whereas professionals do not represent more than 3-4 %.

Hinton, P.S., Sanford., Davidson, M.M., Yakushko, O.F., Beck, N.C. (2004). Nutrient intakes and dietary behaviors of male and female collegiate athletes. *International Journal of Sport Nutrition and Exercise Metabolism*, 14, 389-388.

Nutrient intake and dietary behaviors are different amongst male and female collegiate athletes. This study used 365 athletes from a NCAA Division I university, who completed an anonymous questionnaire. Only 15 % and 26 % of athletes had adequate intakes of carbohydrate and protein, respectively, based on recommendations for athletes. Males were more likely to exceed the Dietary Guidelines for fat, saturated fat, cholesterol, and sodium than females. Sixty-two percent of female athletes wanted to lose at least 5 lbs compared to 23 % of males. The desire to lose weight was associated with decreased energy and macronutrient consumption, but not with inadequate micronutrient intakes.

Magkos, F. and Yannakoulia, M. (2003) Methodology of dietary assessment in athletes: concepts and pitfalls. *Current Opinion in Clinical Nutrition and Metabolic Care* 6, 539-549.

Evaluation of an athlete's diet is important in both clinical practice and research. The main purpose of this study is to provide health professionals with guidance regarding the special issues that are likely to be encountered when assessing the dietary intake of athletes. There are a number of methods may be used for the dietary assessment of individuals and/or groups of athletes, including diet recall, food-frequency questionnaire, and diet history. A 3-day estimated diet record is the most widely used approach, but collection of single or multiple diet recalls is also common. Care must be taken, however, to ensure that days of diet monitoring accurately reflect usual food consumption during the period of interest. Under-reporting of habitual energy intake is widespread among athletes, and its magnitude should be carefully addressed when interpreting the results of dietary assessment. Other issues, specifically related to athletes, that are often neglected include adequacy of standard portion sizes, frequency of snacking, fluid intake, supplement use, weight-control practices, and seasonality of sport

activities and food consumption. There are subtle methodological differences in the dietary assessment of athletes and non-athletes, which, when taken into consideration, may increase the quality of intake data.

Nelson, M.E., Rejeski, W.J., Blair, S.N., Duncan, P.W., Judge, J.O., King, A.C., Macera,

C.A., and Castaneda-Sceppa, C. (2007). Physical Activity and Public Health in

Older Adults. *Journal of the American Heart Association*, 116, 1094-1105.

The college setting presents an important opportunity for health promotion during a critical developmental stage for weight gain. The research and data were derived from a sample of 24,613 students below 25 years of age surveyed in 1993 and 1999. The results showed a prevalence of overweight among the students increased between the two study periods. Males were more likely to be overweight and obese than females, but no difference existed in class II obesity rates with gender. Students were significantly more likely to be overweight or obese in their later years of college.

Rangan, V.V., Willis, L.H., Slentz, C.A., Bateman, L.A., Shields, A.T., Houmard, J.A.,

Kraus, W.E. (2011). Effects of an 8-month exercise training program on off-

exercise physical activity. *Medicine & Science in Sports & Exercise*, 9, 1744-

1751.

An active lifestyle is widely recognized as having a beneficial effect on cardiovascular health. However, no clear consensus exists as to whether exercise training increases overall physical activity energy expenditure or whether individuals participating in regular exercise compensate by reducing their off-exercise physical activity. The authors of this study wanted to assess changes in physical activity energy expenditure in response to aerobic activity, resistance training, and combination of the two. The time span of 8-months was not associated with compensation effect with the activity bouts.

Wansink, D. (2007). Mindless eating. *Environment and Behavior*, 39, 106-123.

Dr. Wansink makes it aware in his findings that people are unaware of food related decisions and how the environment influences these decisions. His first study demonstrates that 139 people underestimate the number of food-related decisions made by an average of more than 221 decisions. The second study of 192 people overate 31% resulting of given exaggerated environmental cue like a larger bowl. The findings had two key points: First, the participants are aware of only a fraction of the food decisions they make. Second, the participants are either unaware of how their environment influences these decisions or are unwilling to acknowledge it.

Appendix A

Research Questions, Assumptions, Delimitations, Limitations, and Definitions

Research Questions

1. Can collegiate club soccer players appropriately balance energy intake and output between in-season and out of season?

Limitations

1. Self-report.
2. Subjects have to do at least 6-8 hours for valid reading
3. Information collected may not be generalizable to other college club athletes.

Delimitations

1. The participants are active individuals besides soccer practice.
2. Participants chosen from Georgia Southern Club Teams.

Assumptions.

1. Accelerometers correctly record exercise data.
2. Participants are honest and accurate in their dietary recalls.

Definitions

1. Compensation theory: suggests that people unconsciously increase or decrease caloric intake because of energy expenditure.

Appendix B: Informed Consent

COLLEGE OF Health and Human Sciences

INFORMED CONSENT

Please read before completing the survey.

1. Marco Ruggiero is doing his research to reveal if there is an imbalance of energy balance either in-season or out-of-season for collegiate club soccer players.
2. We are asking for you to **participant in and out of varsity sport activity**.
3. No identify information will linked to published results. Each participant will be coded for data input; and only the researcher will have participants' codes and the code sheet. All data will be stored in a secured area and only the researcher will have access to the data; data will be discarded after three years.
4. There only **minimal risk** involved, including slight embarrassment from revealing personal experience with the physical activity passport.
5. The **benefit** for you as the participants, from this study by gaining a better understanding of their own energy balance.
6. If you **have questions about this study**, please contact the researcher named above, whose contact information is located at the end of the informed consent. For questions concerning your rights as a research participant, contact Georgia Southern University Office of Research Services and Sponsored Programs at 912-478-0843.
7. This **survey is voluntary and no compensation will be given**. If at any time you do not want to participate, please let inform your nurse or **you may opt not to answer all the questions** on the survey.
8. Penalty: There is **NO penalty for deciding not to participate in the study**.

This project has been reviewed and approved by the GSU Institutional Review Board under tracking number .

Title of Project:

Compensation Theory: Can Club Soccer Players Appropriately Balance Energy Intake and Output In and Out of Season?

Principal Investigators:

Marco Ruggiero, mr02381@georgiasouthern.edu

Participant Signature

Date

I, the undersigned, verify that the above informed consent procedure has been followed.

Investigator Signature

Date

Appendix C: Participant Contact Information

Participant Contact Information
--

Name _____ ID # _____

Address _____

City _____ State _____ Zip _____

Phone number _____

Age _____

Height _____

Weight _____

Accelerometer Number _____