Dietary preferences and compensatory dietary habits related to level of physical activity, Body Mass Index and body fat

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18758

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Abstract

Background
Weight regulation needs a balance between energy intake (diet) and energy expenditure (physical activity). Active people tend to compensate the energy expenditure of physical activity with calorie intake, and some may even over-compensate. But the quality of food intake is variable, which may affect the overall calorie intake. Current research shows that physical activity in adults is not meeting recommendations. Altogether may affect behavior regarding food choice and physical activity.

Purpose
1) Determine if there is a compensatory food intake in free-living people that are generally physically active. 2) Evaluate the quality of food intake in the participants 3) Determine whether people are reaching physical activity recommendations 4) Analyze the behaviors that affect food choice and exercise.

Methods
A cross-sectional study was performed with 16 adults, involved in fitness classes from 2 leisure centers. For a 7-day period, dietary data was logged into MyFitnessPal and physical activity was recorded in accelerometers. After the 7 days, AEBQ, TFEQ R-18 and BREQ-2 questionnaires were completed online.

Results
Calorie intake difference between active and non-active days was of -3.92% (SD 29.5), with no observed compensation. Calorie intake in weekdays correlated to the intake in weekends (r=0.688 p<0.05). 330 minutes was the weekly MVPA (average). MVPA in weekdays was correlated with calorie intake in weekends (r=-0.608 p<0.05).

Conclusions
No compensatory habits were found in active people. Higher calorie intake was obtained in active days. The distribution of intake in meals was predominant in dinner, in both active and non-active days. Snacks occupied a high proportion or energy intake. Cognitive restraint was a behavior (TEFQ R-18) highly correlated to calorie intake. MVPA was achieved in most of the participants completing more than double of the recommendation time. The BREQ-2 suggested a higher level of autonomous behavior in participants as physical activity behavior.
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Author’s declaration

I declare that the work in this dissertation was carried out in accordance with the requirements of the University’s Regulations and Code of Practice for Taught Postgraduate Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, this work is my own work. Work done in collaboration with, or with the assistance of others, is indicated as such. I have identified all material in this dissertation which is not my own work through appropriate referencing and acknowledgement. Where I have quoted from the work of others, I have included the source in the references/bibliography. Any views expressed in the dissertation are those of the author.

Signed ......................................

Date .............................................
SAMPLE ......................................................................................................... 29
DATA COLLECTION ...................................................................................... 30
Measurements .............................................................................................. 31
DATA PROCESSING .......................................................................................... 33
DATA ANALYSIS ............................................................................................ 35

RESULTS ........................................................................................................... 36
Participants ....................................................................................................... 36
ASSOCIATIONS BETWEEN VARIABLES .......................................................... 37
  BMI categories, Fat Percentage categories and Total MVPA time and Total calorie intake........................................................................... 37
  Physical activity intensity and Caloric intake .................................................. 38
  Cognitive restraint (TFEQ) and Caloric intake ................................................. 38
  AEBQ and caloric intake ................................................................................ 39
  BREQ-2 and MVPA ......................................................................................... 39
  Nutrients consumed and nutrients required .................................................... 40
  Caloric intake and compensation ..................................................................... 41
DIFFERENCES BETWEEN BMI AND FAT PERCENTAGE CATEGORIES .......... 43
MEAL AND SNACK CONTRIBUTIONS TO ENERGY INTAKE ON ACTIVE AND NON-ACTIVE DAYS ................................................................. 43

DISCUSSION ...................................................................................................... 45
MAIN OUTCOMES ............................................................................................ 45
  Dietary outcomes .......................................................................................... 45
  Physical activity outcomes ............................................................................ 47
STRENGTHS AND LIMITATIONS ..................................................................... 49

CONCLUSIONS .................................................................................................. 50

REFERENCES .................................................................................................... 51

APPENDICES ..................................................................................................... 57
Appendix1.  a) Jackson and Pollock (1978) fat percentage for men and women; b) ACE (American Council on Exercise) categorization of fat percentage. ............................................................................................................. 57
Appendix2. BREQ-2 .......................................................................................... 57
Appendix3. AEBQ .............................................................................................. 58
Appendix4. TFEQ R-18 (Cognitive Restraint construct) ..................................... 59
Appendix5. MyFitnessPal instructions ................................................................ 60
Appendix 6. Calorie Intake per participant according to active and non-active days .................. 63
Appendix 7. Between-day calorie intake differences (%) from each participant ....................... 68
Appendix 8. ANNOTATED SYNTAX AND SPSS SCREEN SHOTS .............................................. 69

RECORD OF MEETING WITH ADVISER .................................................................................. 74

Tables

Table 1 Dietary Reference Value (DRV %) for adults ................................................................. 15
Table 2. Relative Autonomy Index (RAI) for each construct to get a final score .................. 32
Table 3. Physical activity intensity cut points: Freedson 1998 used in Kinesoft .................. 34
Table 4. Estimated Energy Requirements formulas (IOM (Institute of Medicine), 2005)
EER: Estimated Energy Requirements, PA: Physical activity Coefficient; PAL: Physical Activity Level ........................................................................................................................................................................... 34
Table 5. Distribution of the sample according to BMI (Normal: < 25, Overweight: 25-29.9, Obese: > 30) ................................................................................................................................................................................. 36
Table 6. Distribution of the sample according to Fat percentage (Appendix 1) .................. 36
Table 7. Averages of MVPA, sedentary time and caloric intake in weekdays and weekends.
The table shows the average values of MVPA achieved and sedentary time in participants, in addition to a total count of the calorie intake. Mins = minutes; Kcal = kilocalories; SD = Standard Deviation ................................................................................................................................................................................. 37
Table 8. Correlations between BMI and Fat percentage categories with Total MVPA and calorie intake ................................................................................................................................................................................. 37
Table 9. Correlations between MVPA and sedentary time ................................................................................................................................................................................................................................................. 38
Table 10. MVPA correlations with total caloric intake in weekdays and weekends (*p<0.05  **p<0.01) ................................................................................................................................................................................................................................................. 38
Table 11. Correlation between the cognitive restrained measured in the TFEQ and the caloric intake in weekdays and weekends. (TFEQ = Three Factor Eating Questionnaire) (*p<0.05  **p<0.01) ................................................................................................................................................................................................................................................. 39
Table 12. Correlations of AEBQ constructs with total caloric intake (*p<0.05  **p<0.01) ................................................................................................................................................................................................................................................. 39
Table 13. Correlations between BREQ-2 and MVPA time in weekdays and weekends.
Table 6 shows the correlation between the score in the BREQ-2 in comparison with the amount of MVPA performed in the weekdays and weekends. .................................................. 40
Table 14. Correlations between the differences found in nutrients (expected-consumed) ..40
Table 15. Mean values of calories intake in active and non-active days .......................41
Table 16. Correlation between the average difference of caloric intake in weekdays and
weekends and MVPA(*p<0.05   **p<0.01).................................................................42
Table 17. Average between-days differences of caloric intake .....................................42
Table 18. ANOVA between BMI categories, total calorie intake and MVPA......................43
Table 19. ANOVA between fat percentage categories, total calorie intake and total MVPA. .................................................................................................................43
Table 20. Calorie intake classification per meal and snacks on a week – Frequencies (%) 43
Table 21. Calorie intake classification per meal and snacks on active and non-active days –
Frequencies (%)........................................................................................................44

Figures

Figure 1. Global prevalence of obesity (Source: WHO)(WHO 2015c).............................13
Figure 2. Prevalence of Obesity in England 1993-2013. (Source: Public Health England -
Health Survey England 2010 and Health Survey UK 2007, 2008 and 2010)..................14
Figure 3. Diagram that summarizes the weight regulation mechanisms. POMC:
Propiomelanocortin, CNS: Central Nervous System, PP: Pancreatic Polypeptide, GLP-1:
Glucagon-Like Peptide, PYY: Peptide YY, CCK: Cholecystokinin(Williams & Elmquist
2012; Lenard & Berthoud 2008).........................................................................................18
Figure 4. Summary of Weight Regulation Models ..........................................................20
Figure 5. Algorithm of recruitment process .....................................................................30
Figure 6. Nutrients calculation per participant.................................................................41
LIST OF ABBREVIATIONS

PA= Physical Activity
EE= Energy Expenditure
EI= Energy Intake
ES= Energy Storage
RMR= Resting Metabolic Rate
WHO= World Health Organization
NDNS= National Diet and Nutrition Survey
DRV= Daily Recommended Value
TFEQ= Three Factor Eating Questionnaire
BREQ= Behavioral Regulation in Exercise Questionnaire
AEBQ= Adult Eating Behavior Questionnaire
MVPA= Moderate to Vigorous Physical Activity
CENHS= Centre for Exercise, Nutrition and Health Sciences
NICE= National Institute for Health and Care Excellence
SACN= Scientific Advisory Committee on Nutrition
BMI= Body Mass Index
NHS= National Health Service
COMA= Committee on Medical Aspects of Food and Nutrition Policy
RMR= Resting Metabolic Rate
CART= Cocaine-Amphetamine-Regulated Transcript
POMC= Propiomelanocortin
AGRP= Agouti-Related Peptide
NPY= Neuropeptide Y
CNS= Central Nervous System
PP= Pancreatic Polypeptide
GLP-1= Glucagon-Like Peptide
PYY= Peptide YY
CCK= Cholecystokinin
MC4R= Melanocortin
CH= carbohydrates
GI= Glycemic Index
NHANES= National Health and Nutrition Examination Survey
SDT= Self-Determination Theory
CR= Cognitive Restraint
FR= Food Responsiveness
SR= Satiety Responsiveness
ENHS= Exercise, Health and Nutrition Sciences
CV= Coefficient of variability
ICC= Interclass Correlation Coefficient
RAI= Relative Autonomy Index
EER= Estimated Energy Requirements
PAL= Physical Activity Level
BOS= Bristol Online Survey
ANOVA= Analysis of Variance
SPSS= Statistical Package for the Social Sciences
Kcal= kilocalories
SD= Standard Deviation
r= Pearson correlation
p= significance
ACE= American Council of Exercise
INTRODUCTION

Obesity has been affecting global population for the past 20 years. (Mitchell et al. 2011) In the most affected countries, different strategies and interventions have been promoted to target the problem, to induce healthy lifestyles and improve quality of life. These strategies include focused points on reducing food intake (or improving the quality of the products) and increasing physical activity (in addition to reducing sedentary times). (Vandevijvere et al. 2015)

For that purpose, public health guidelines for nutrition and physical activity have been formed to have a correctly channeled method in how to achieve a healthy weight. These guidelines are structured on evidence-based recommendations that indicate what is good for health. They are specific for the different age groups and pre-existing health conditions that may need a variation of “normal” requirements. (NICE 2015) Guidelines may also vary by country, depending on what evidence shows benefit to the population.

Regarding physical activity, guidelines are introduced in a way were people can achieve a healthy lifestyle, maintain weight or even achieve weight loss. However, studies are at the moment in development to determine the effect of the pointed recommendations with weight gain prevention and reduction of other chronic diseases. (Moholdt et al. 2014) For nutrition, recommendations for healthy eating are based on percentages of necessary nutrients within the overall food intake; based on them, guidelines for healthy weight maintenance are also proposed. (SACN 2011) The reduction of saturated fat intake, the increment of fruit and vegetables with the “5 a day” campaign, the increase of water consumption, among others; are some examples of the current nutrition recommendations. However, figures still denote increments in obesity, probably due to a lack of balance in energy intake and expenditure or the absence of guidelines adherence. (SACN 2011)

Many factors have been determined as influential in the energy balance (energy intake and energy expenditure must remain equal for weight maintenance). These factors are physiological, psychological, genetic and environmental. All of these as a whole contribute to body composition and weight, and all of them form what are called theories of weight maintenance. (Speakman 2013) The theories are the view of professionals with different backgrounds, but together they explain the diverse mechanisms the body; with influences of external factors affecting the choice of an individual, and later on, the reasons of their inability to maintain a healthy weight and lifestyle. (Speakman 2013)

Different studies have measured energy intake modifications through variations of physical activity (PA) intensity, in free-living settings (repeated-measures) and controlled
environments, and in men and women physically active. From these studies, it is known that physically active adults usually maintain a healthy diet. (Wilcox et al. 2000; Pomerleau et al. 2004; George & Morganstein 2003; Lluch et al. 2000) Due to these studies, hunger mechanisms have been shown to get reduced by improvements in homeostatic control of appetite as well as other psychological mechanisms, such as a suppression of the urge to eat, that has also been associated with exercise. Yet, this may not imply that energy intake (EI) will also decrease.

Studies suggest that as a way to compensate the energy consumed in exercise (energy expenditure), people may increase the levels of EI through the increment in food intake (19% of short-term and medium-term interventions), probably due to the aforementioned psychological and physiologic responses. (Pomerleau et al. 2004; Blundell & King 1999) Blundell et al used 25 short-term and 6 medium-term studies with no specific time determined, he also used mixed protocols of physical activity. What the author mainly assessed were the changes of EI after a workout session in specific populations (men and women, lean and obese). However, due to the limitations of the study (lack of evaluation between days that may have been influenced by exercise and the short-term studies due to time) compensation was not found. (Blundell & King 1999)

Nutritional aspects such as preferences in food intake and compensatory habits, may be modified by the level of physical activity and gender (women seem to show compensatory behaviors the days following a high intensity physical activity). (Pomerleau et al. 2004) Furthermore, evidence has shown that compensatory habits are also affected by the body fat and body mass index (BMI). (King et al. 2012)

Whilst there has been studies that show modifications and compensation in energy intake because of the amount of energy expended, there have been others that suggest the contrary, as discussed previously. These contradictions, trying to determine food or energy intake modification post-exercise, are used as a groundwork to the objectives of this study. In addition, the lack of more “free-living” studies, that is with subjects in an uncontrolled environment, that support the presence or lack of compensation habits in physically active people, suggest the need to investigate further on. This is particularly evident with regards to the compensatory mechanisms and the determination of how the psychological and environmental factors may influence compensation.

The main aim of this study is to determine if there is a compensatory food intake in free-living people that are generally physically active, in two leisure centers in Bristol and to
evaluate the psychological and environmental aspects that lead to choices of physical activity and nutrition. A secondary aim is to evaluate the quality of food intake in the participants; and thirdly, measure the total amount of physical activity to determine whether people are reaching physical activity recommendations.
LITERATURE REVIEW

THE OBESITY EPIDEMIC

Obesity is defined as an abnormal or excessive body fat accumulation that presents a risk in health. Using Body Mass Index (BMI) it is defined as a value over 30kg/m². (NHS 2015) Globally, in the last two decades, the prevalence of obesity has been increasing notoriously worldwide, giving concerns due to its impact in health and economics in the world. (WHO 2015a)

In 2008, the World Health Organization (WHO) reported more than half a billion people worldwide were obese (65% of the world population), doubling its prevalence from 1980 to 2008, and showing a higher mortality rate than underweight. It is related to several chronic diseases such as diabetes, stress and heart diseases. (WHO 2015a; WHO 2015c)

The global prevalence of obesity is shown in Figure 1. The highest prevalence of obesity is found in the United States (US), followed by several other developed countries.

![Figure 1. Global prevalence of obesity (Source: WHO)(WHO 2015c)](image)

In 2013, half of the United Kingdom (UK) population of adults had weight issues (overweight in around 62.1% and obesity in 67.1% of men and 57.2% of women). Overweight and obesity have become one of the main public health priorities in the UK health system, and campaigns tacking this problem have started to become more frequent.

In Figure 2, it is shown the increasing prevalence of obesity from the years 1993 to 2013 in England (from a 14.9% to a 24.9%) which have started to slow down, but still growing. (Public Health England 2014)

In the UK, Scotland has the highest prevalence (1995-2010) of obesity in the UK, followed by England, Northern Ireland and Wales. (Public Health England 2013)
Even though various strategies have been employed in different countries, governments seem to have problems in reducing the prevalence of obesity. Interestingly, evidence has not given enough data that supports the positive effects and results of the continuous interventions targeting weight loss or weight maintenance. (Public Health England 2013) In 2011 the UK government published *Healthy Lives, Healthy People: A call to action on obesity in England*, were the goals and the strategies that were to be implemented in the country were explained. Strategies as *Change4Life* to promote physical activity and healthy eating behaviors, and structured guidelines, such as the PA guideline *Start Active Stay Active*, were mentioned to be one of the most important factors to help tackle obesity. Other approaches by local governments and businesses has been also implemented: food packs labeling system improvement (such as giving nutritional caloric facts of food to improve healthier choices in local food chains) or the use of the *Eatwell Plate* (diagram that shows food groups portions recommended for healthy lifestyles) reinforcement to provide a healthier eating lifestyle. (Department of Health 2011).

**WEIGHT MANAGEMENT: MEETING THE GUIDELINES**

Guidelines have been made for people to contribute in healthy lifestyles choices. There is evidence that support these guidelines, based on studies that show the benefit of each topic. By meeting these, people should achieve a good quality of life.
Guidelines for nutrition are rather complex. It varies according to the energy that is required for each individual. In 1990, policies made by the Committee on Medical Aspects of Food and Nutrition Policy (COMA) in the UK, made recommendations on healthy adult men depending on the age group. However, energy requirements also depend on weight, height and the physical activity level. That is the main reason why accurate energy requirements measurements are based on thorough calculations that use those variables. (SACN 2011) In general, range levels from 2500 to 2780 kilocalories (kcal) per day are the energy requirements in adult men, and 2000 to 2175 kcal are for healthy adult women (Table 1 show these requirements for each nutrient). The NICE (National Institute for Health and Care Excellence) guidelines give more recommendations focusing on maintaining healthy weight and preventing excess weight gain. It also provide various recommendations on eating behaviors. Recommendations include vegetables, fruits, beans, wholegrains and fish, with the avoidance or reduction of food with high energy density. It follows the NHS (National Health Service) choices, which recommend the limitation of red and processed meat up to 70g a day. (NICE guidelines 2015)

<table>
<thead>
<tr>
<th></th>
<th>DRV, % of daily total energy intake (including alcohol)</th>
<th>DRV, % of daily total energy intake (excluding alcohol)</th>
<th>Average British adult intakes, % food energy intake (Source: NDNS, 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Total Carbohydrate</td>
<td>47</td>
<td>50</td>
<td>47.5</td>
</tr>
<tr>
<td>Of which non-milk extrinsic sugars</td>
<td>10</td>
<td>11</td>
<td>12.8</td>
</tr>
<tr>
<td>Total fat</td>
<td>33</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Of which saturated fatty acids</td>
<td>10</td>
<td>11</td>
<td>12.8</td>
</tr>
<tr>
<td>Polyunsaturated fatty acids</td>
<td>6*</td>
<td>6.5</td>
<td>6.1</td>
</tr>
</tbody>
</table>

*An individual maximum of 10% applies (with an individual minimum of 0.2% from linoleic acid, and 1% linoleic acid)

Table 1 Dietary Reference Value (DRV %) for adults

Average total fat intakes in adults are now close to the target of 35% of food energy from fat but the percentage of energy derived from saturated fatty acids is higher (13%) than
the recommended 11% of food energy. (NICE guidelines 2015) Furthermore, the average diet for an adult in the UK, contains too much added sugar and salt and too little fiber, and on average fruit and vegetables intake is less than 3 portions a day, even though in the year 2003 the Department of Health introduced the 5 A DAY campaign.

The National Diet and Nutrition Survey (NDNS) was published in 2014, and gave data from the UK in the years 2008-2012. Data shows an average of energy intake consumption, of 2151kcal/day in men and 1614kcal/day in women (total average in the adult population of 1884kcal/day); protein intake was found to be above the recommended intake with a 17-18% of the total energy intake; total fat and carbohydrates were consumed under 35% and 50% respectively, meeting the recommendations. Nevertheless, added sugars exceeded the recommended amount with an 11% of the overall food energy intake, and saturated fat, in average, with a 12.6% of the overall energy food intake. (Bates et al. 2012)

Physical activity

Physical activity (PA) is one of the contributors to help regulate weight by controlling energy expenditure. In 2011, the UK public health system has recommended PA guidelines that would educate in the benefits on being physically active and reducing as much as possible sedentary time in all age ranges. Specifically in adults, the guidelines mention the importance of doing a minimum of 150 minutes per week of moderate PA that could be divided into 30 minutes 5 days a week; this can also be achieved by doing 75 minutes a week of vigorous PA; or even alternating between moderate and vigorous PA. Muscle strength should be combined with PA at least two times a week, and finally, reducing as much as possible sedentary. (Davies et al. 2011) Based on these, the NICE guidelines for obesity prevention and management recommend that in addition to exercise, people need support of dietary regulations and in some cases, behavioral therapy support. Furthermore, if a person is not conducting any reduction of energy intake in the dietary regulations, an increment in the total time of physical activity should be installed, being from 45 to 60 minutes of moderate to vigorous physical activity (MVPA) daily. In the case of people with obesity, once weight loss is achieved, the MVPA time should be modified towards 60 to 90 minutes daily. (NICE 2015)

In the UK, 67% of adult men meet the “Start active, Stay active” recommendations, being the highest prevalence in the age group between 16-24 years old. In women we see a lower achievement with only 55% of them being physically active and meeting the
requirements. Nevertheless, the trend follows the same path in both men and women, showing a lower prevalence as they get older. (British Heart Foundation 2015)

These guidelines were made with evidence supporting each statement. In the case of PA guidelines in the UK, each recommendation was supported with systematic reviews from other countries’ (Canada, USA) PA guidelines and compared to those from the UK. Each study evaluated the preventive effects in the population in short and long term, reaching a consensus of the appropriate recommendations. (Davies et al. 2011) However, these do not seem to have any effect on people according to the Joint Health Surveys Unit (2013) and Health Survey for England 2012 analyses. More up-to-date data would be useful to evaluate whether the recommendations along with PA interventions have had a positive effect on the population. (British Heart Foundation 2015)

**WEIGHT REGULATION**

For the body to maintain weight, there must be a balance between energy intake (EI), energy expenditure (EE) and energy storage (ES). Energy intake basically means the amount of caloric consumption through food intake and energy expenditure can be achieved through normal physiological processes such as resting metabolic rate (RMR) and metabolizing food, or external processes for example with physical activity. When an unbalance between these occur, body weight could change, leading to weight loss or gain. Yet, there is also the component of energy storage. This ES is used as a buffer to prevent changes in body mass when there is a lack of energy intake so there are no constant variations in weight. (Hill et al. 2012; Hall et al. 2012a)

Still, many theories of weight regulation have been developed and modified in the last decades, trying to explain the mechanisms in which this balance is controlled, but in order to talk about them, it is important to know the several factors that contribute to each theory, and how they work in the body.

*Genetics influence*

Several studies have given evidence about the role of genetic factors in obesity. In studies with monozygotic twins and dizygotic twins have shown that the first ones have a higher relation with fat mass with a 70-90% in comparison with dizygotic twins which do
show a relation but is lower (30-45%). (Hall et al. 2012a) In addition to this, studies show correlations in BMI in adopted children with their biological parents, and as well between each other if separated at birth. These shows how even when environment might be different, heritability still plays a role in weight and body composition. (Xia & Grant 2013)

Physiological mechanisms

Physiologically, the body has various signals that determine the production of peptides, hormones or neurotransmitters that contribute in weight regulation. Even though these signals are determinant for survival, they are not entirely precise in measuring the total amount of energy that has been used.

The main center of processing and regulation is in the hypothalamus. It combines gastrointestinal, peripheral circulation and brain signals to control intake and energy expenditure by the production of substances that will inhibit (cocaine-amphetamine-regulated transcript [CART] and POMC) or induce (agouti-related peptide [AGRP] and neuropeptide Y [NPY]) appetite. All these peptides interact with receptors (mechanical or chemical) in the other levels, regulating the production of different hormones that modulate intake, satiety and expenditure. (Farias et al. 2011)

Figure 3. Diagram that summarizes the weight regulation mechanisms. POMC: Propiomelanocortin, CNS: Central Nervous System, PP: Pancreatic Polypeptide, GLP-1: Glucagon-Like Peptide, PYY: Peptide YY, CCK: Cholecystokinin (Williams & Elmquist 2012; Lenard & Berthoud 2008)
Psychological mechanisms

Psychological mechanisms are also found to be influencing factors in weight balance. Everything that people eat, creates different sensations rather as rewarding or as limiting for food intake.

These mechanisms work through an effect as ‘wanting’ or ‘liking’ to eat food. It is produced by brain activity that emulates that ‘wanting’ sensation, making the hypothalamus give signals to the body to promote it as hunger. But in a state of hunger absence, these signals are stimulated in other areas of the brain, which suggest that ‘wanting’ and ‘liking’ are not the same as physiological involuntary signals that induce the need to eat food. For example, stress has been found as an exacerbating factor for over-eating even when hunger is absent, but this over-eating appears even when hunger is not present, reducing the reward, which could induce to over-eating as well. (Moore 2000; Hall et al. 2012a)

In practical terms, people who are able to regulate intake (hunger) with energy expenditure and with reward, should be able to reduce appetite responses, avoiding overeating. Those who are not able to do so, gain weight.

Environmental factors

Environment is known to influence more on energy intake than expenditure, so it is now thought it works as an obesogenic (promotes obesity) factor.

Food nowadays has become more accessible, bigger on portion sizes and higher in energy, fat and sugar. Companies have larger campaigns promoting this type of food and people are reacting positively towards this. This is causing people to increase energy intake. (WHO 2015b)

Physical activity on the other hand has been in some ways positively modified and in others replaced by technology. According to data from 2015 from the World Health Organization (WHO) one in every four adults are not active enough. (WHO 2015d) The more the world develops new modes of transportation and entertainment artifacts that help increase sedentary time, the more negatively affected physical activity would be found in people, which would decrease energy expenditure. Physical activity is known to have also effect on resting energy expenditure which would be a passive way of balancing intake with energy expenditure, because of its effects on skeletal muscle tissue. (Hall et al. 2012a)
Weight maintenance theories

There are many models that may explain how body weight is maintained. They involve the participation of different factors that are known to interact as contributors in weight regulation. These are environmental factor, genetic factor, physiological response and psychological interaction.

**SET POINT REGULATION MODEL**

This theory is based on physiological response, genetics and environmental factors. Essentially, a “set point” is genetically established in the hypothalamus to maintain weight. As food intake and other environmental elements (e.g. temperature) are detected by the set point, a negative feedback is originated and fat storage is controlled physiologically. Consequently, as body fatness increases or decreases the “set point”, the body regulates weight by a modification of food intake (energy intake), changing eating behavior and by a modification in energy expenditure, changing exercise habits (Speakman 2013; Harris 1990).

This theory fails to clarify how, if the system has a well-controlled feedback process, obesity exists. Besides, it does not explain why more people are tending to increase weight over the years; and why it varies depending on their socio-economic status, sedentary life or life circumstances (college, marriage), among other environmental factors that may influence weight. (Speakman et al. 2011)
SETTLING POINT REGULATION MODEL

This model works on bases with social, nutritional and environmental factors. It does not work with a predefined set point but it works with a self-regulating point (passive) that may vary according to the intake and expenditure. Thus, by making equal the expenditure according to the level of intake, weight (or fat storage) is maintained. Still, if intake is lower than expenditure, the required energy needed for metabolic expenditure would decrease (for lean tissue and fat would lessen), but as soon as the amount of tissue and its metabolic rate balances with the intake, no more weight loss would be found, and the settling point would be reached. The same process would happen if there is an increase with energy intake, but in this time, increasing energy expenditure. Although the body would still intends to go back to its original state and weight would be gained, the balance would be actually reached. This theory bases more on the environmental factor, explaining how weight may be controlled even when there are various inputs such as the type of food and food availability in the surroundings. (Speakman 2013; Speakman et al. 2011; Farias et al. 2011)

GENERAL MODEL OF INTAKE REGULATION

The model is based on a combination of physiological regulation, environment, social input, psychological response and dietary factors. This is an alternate idea in which a combination of all the factors contribute to weight management. It is divided into two sets: an uncompensated set mostly influenced by the environment, which is not affected by intake; and the compensated set, mostly influenced by physiological responses, which is determined by a negative feedback with the intake. This model locates each person as an individual, everything regulates depending on the heredity. It does not work with a set point, because the modifications made will be depending on the intake that is a result from the two sets acting together. Everything is flexible because it depends on the amount of uncompensated factor and how the body responds with the compensated factor, even though, sometimes if there is a balanced intake and expenditure, it could seem to work as the set point model. (Speakman 2013)

DUAL INTERVENTION POINT MODEL

This model is based on genetic and environmental factors. It works with upper and lower “boundaries” instead of set points, giving a range for the body to have a physiological response to any changes in food intake and expenditure. There are boundaries, and these are
set up by two intervention points: a lower point in which the body regulates weight by controlling and reducing energy expenditure if the weight is under the boundary; and an upper point where only when the upper point is crossed, when the body stops gaining weight. These intervention points seem to be controlled by genetics, through specific genes that have been found to determine weight such as FTO, BDNF and SH2B1 or by neuropeptidic systems working through MC4R (Melanocortin) or POMC (Propiomelanocortin). (Xia & Grant 2013; Moore 2000)

**THE COMBINED EFFECTS OF PHYSICAL ACTIVITY AND FOOD INTAKE IN WEIGHT REGULATION**

As previously mentioned, both physical activity and food intake help determine weight, by regulating energy intake and expenditure.

*The role of diet in weight regulation*

Nutrition plays one of the most important roles in weight. Nowadays, nutrition is a key component in people’s lifestyles, especially in those who try to control weight. The amount of food intake has been increasing over the years, contributing to weight problems in big populations. Nonetheless, what is most concerning is the quality of the products related to that food intake increase.

Many factors in the individual’s way of living are part of their nutrition and influence weight. One of them is ‘snacking’, a behavior that may increase the eating frequency. Inadvertently, some of the ‘snacks’ can represent a high percentage of the daily energy intake in many people. Others may be affected by the eating pattern with restrained periods and disinhibited eating. Even though restraint has been known to control intake, rigid periods of restriction may induce a following disinhibition and overeating, with a result of weight gain. This could be related to eating disorders such as binge eating that have been studied extensively. Another important factor influencing nutrition is eating out. This has been increasing alongside weight problems such as obesity, diabetes and hyperlipidemia. For instance, in the US population, studies have found that over half of the income designated for food, is now expended on dining out. The problem with this is that food in restaurants (including fast food) has poor quality in general: has higher energy contents, saturated fat
and sodium. On the other hand, food prepared at home has reduced fat contents. Following this idea, is not surprising that people eating out have a higher BMI than people who prepare their meals at home. (Hall et al. 2012b)

The composition and the amount of the food that is being consumed by individuals is a main factor of weight variations. There is some controversy regarding the meaning of high fat or high carbohydrate consumption in the diets, particularly about the role of that consumption in weight gain. Studies show contradictory results: some with positive relationship between high fat consumption and obesity compared to low fat consumers, others with a higher relationship for carbohydrate consumption rather that fat. Still, fat has a higher energy content compared to carbohydrates or proteins. What is also important is that carbohydrate foods tend to have a combination with other composites such as water and fiber, which could help with energy balance. In respect of the satiety factor, fat is known to have a low satiation time (because of its energy density), low thermic effect and low in energy metabolic consumption. Therefore, fat could represent a factor responsible in overeating.

Carbohydrates (CH) are divided into different categories, each of which could have its beneficial and unhealthy sides. The “free sugars” (disaccharides) are the ones contributing to weight gain. One example is sugar-sweetened beverages, which start affecting the population from young ages, playing an important role in the developing of some chronic diseases such as diabetes and hyperuricemia. Another important factor in CH is the glycemic index (GI). This is the effect that glucose produces in the body and how insulin counteracts to balance it. The lower the GI is, the higher the satiety it promotes in the organism, for it produces physiological changes with gut hormones, thus, inducing satiation. Finally, the “dietary fiber” (polysaccharides) is a protective factor that may induce weight loss, especially in overweight people, because it stimulates hormonal effects that control gastric movements, and its process of fermentation at colonic level which would induce satiety. (Hall et al. 2012a) On the other hand, there is alcohol. It could be considered as part of carbohydrates for its amount of sugar on it, however it is studied separately from it, but still it has a different calorie composition as well, this being higher. Even though it is thought to have a contribution to weight gain, many studies have only shown contradictory results, with an overall of a moderate relationship in men and only suggestive for women. (Moore 2000; Swinburn et al. 2004)

On its behalf, proteins have a high satiety response in the body, so it could be considered as the type of food used to prevent weight gain. In *ad libitum* conditions, it has
been found to have a more beneficial effect, as people tend to reduce energy intake as well, incrementing chances of weight loss. (Westerterp-Plantenga et al. 2012)

The role of physical activity in weight regulation

Physical activity has been known to be an important regulator of weight. Evidence has shown that by achieving a certain amount of PA, energy expenditure control can be achieved, creating a balance between energy intake and weight. (Moore 2000) It is also known that exercise increases the resting energy expenditure by using lean mass, increasing oxygen consumption during exercise sessions and helping with weight reduction. Body mechanisms such as vowel movements, stomach emptying in a faster rate, and activation of peptides occur during chronic exercise (mild to moderate physical activity). This has been proven in studies that used moderate and vigorous physical activity (MVPA), as well as cardiorespiratory fitness. (Hall et al. 2012a; Swinburn et al. 2004)

However, if the expenditure gained by physical activity remains lower than the energy intake, weight still would increase. Correct balance between energy intake and energy expenditure is the most effective way for maintaining weight, but if lower intake and higher expenditure is found, weight loss might be achieved.

A cross-sectional study was performed with data from the National Health and Nutrition Examination Survey (NHANES-1) where the level of PA (leisure and occupational) was correlated with weight gain in a 10-year period. The findings showed that the reduction in leisure and occupational PA contribute to weight gain, with 3 times greater risk of weight gain in men and 3.8 times in women [RR=3.1 (95% CI = 1.6-6.0) and 3.8 (2.3-6.5) respectively]. (Williamson et al. 1993)

INTAKE COMPENSATION

Intake compensation is when energy intake is consciously increased when energy expenditure has been apparently high (for example with an intense workout session), thus preventing weight loss to be achieved, or in another case, being able to maintain a current weight. There have been studies that suggest that this compensatory habits occur in normally active people but that may differ according to the BMI and gender. In general, people tend
to over-eat after exercise sessions, and this may differ from days in which they are not physically active. (Hall et al. 2012b)

Studies have attempted to measure this compensation by quantifying the amount of energy intake with observational methods, or by measuring intake in free-living people with others, such as food diaries. In addition to this, energy expenditure has also been quantified using calorimetry or VO2max tests (maximum volume of oxygen consumed during exercise). (Riou et al. 2015; Lluch et al. 2000) One of the problems with these studies is that most of the evidence has been obtained in a controlled environment, showing contradictory results.

**Supporting evidence**

Mainly, the literature suggests that physically active people do not tend to counterbalance the energy that has been expended through physical activity (energy expenditure) with an increased energy intake through higher food intake. However, most of these studies that showed this, have found that there seems to be a discordance in lean participants with overweight and obese participants. The assumption is that this is caused by the lower body fat reserves that may induce body responses that induce more energy intake, thus compensating the energy that has been expended. (King 2008) Others suggest that the cause of this contradictory data is the amount of time of the intervention or observational period that has not been enough to visualize the modifications in compensation of the energy expenditure with intake. Still, more studies are in continuant evaluation of these, finding even more interesting results.

In a systematic review of 61 studies, it was found that the most important and mediator factor influencing compensation were age, initial fat mass and the duration of the study, with an overall compensation of 18% of the energy expended. (Riou et al. 2015) Other studies have focused on evaluating this compensation by gender. Stubbs et al suggested that men tend to fail in compensating their energy expenditure lost in exercise even in long periods. This trial was conducted in free-living men with protocols of PA intensity days and measuring intake with food diaries and self-weighted intake. (Stubbs et al. 2002) For their part, women do seem to have a compensatory mechanism. This was found in a randomized controlled trial, where 13 women were put into different groups (low intensity, high intensity exercises at 40% and 70% of VO2max uptake) and posterior *ad libitum* buffet to measure intake; the results showed the compensation in an increased proportion in the higher intensity exercise
in comparison to the low intensity exercises (91% and 40% respectively). (Pomerleau et al. 2004)

Other studies mentioned the lack of compensation in energy intake, but found a negative energy balance in the results, all in longer periods of time (at least 7 days) (Whybrow et al. 2008; Stubbs et al. 2004) Time has also shown to be a factor that affects the grade of compensation, as previously mentioned. This might be due to the ability of the organism to physiologically adapt to the amount of energy expended during physical activity.

The lack of more clarifying data has led to the current research study, in which the evaluation of compensation, and the probability of over compensation in physically active people has been measured.

The intention of this study is to quantify with self-reported nutritional log the total amount of energy intake (focusing as well on the overall food composition) and compare it to the amount of physical activity performed. In addition to this, a double analysis in the participant’s intake would be done, to verify changes in intake within active and non-active days. Questionnaires have also been completed in order to analyze the psychological aspects of food intake and choices and physical activity.

**NUTRITION AND PHYSICAL ACTIVITY QUESTIONNAIRES**

As mentioned earlier, there are diverse mechanisms that may influence the energy balance, including environmental and psychological factors. One effective way of measuring nutrition and PA is with the use of questionnaires. The importance of the evaluation of these questionnaires rely on the free-living context in which this study is performed, therefore being able to measure the response of the participants after being physically active without having a more observational control. (Wardle et al. 2001)

**BEHAVIORAL REGULATION IN EXERCISE QUESTIONNAIRE (BREQ) (Appendiz2)**

The Behavioral Regulation in Exercise Questionnaire is a questionnaire that intend to measure what motivates people to perform physical activity, based on the afore-stated self-determination theory (SDT).
The constructs usually measure 6 ways in which exercise can be regulated: amotivation, external regulation (ER), introjection, identification, integration, and intrinsic regulation (IR). Individually, these form non-self-regulatory and self-regulatory mechanisms that intend to show how external and internal factors act upon own goals, and recognizing the importance and satisfaction of the activity their performing. (Markland & Tobin, 2004)

**ADULT EATING BEHAVIOR QUESTIONNAIRE (AEBQ) (Appendix3)**

The Adult Eating Behavior Questionnaire (AEBQ) is a questionnaire that is being developed as a tool to measure eating behavior in adults. It is derived from their previous questionnaire, the Children’s Eating Behavior Questionnaire that was developed in 2001 to assess eating style in children that may be involved in the child’s weight, including Food Responsiveness (FR) and Satiety Responsiveness (SR). These concepts refer to the way people react to food, and how they control the subsequent food after the intake of snacks. In the adult version includes also aspects that measure hunger as an obesogenic factor. (Wardle, et al., 2001)

It is divided into different constructs that measure hunger, FR, SR, emotional over and under-eating, enjoyment of food, and food fussiness and slowness in eating, that have shown internal and external reliability (Cronbach’s alpha >0.7) (Hunot, et al., 2015).

**THREE FACTOR EATING QUESTIONNAIRE (TFEQ R-18) (Appendix4)**

The Three-Factor Eating Questionnaire (TFEQ) is a questionnaire that was developed in 1985 by Stunkard and Messick, to analyze eating behaviors in obese people, which is now also applied in overweight and normal weight subjects. It was made due to the lack of clarity with other scales that attempted to measure restraint and “latent obesity” (concept that catalogued people as genetically obese but maintaining a normal weight by intake restraint). (Stunkard & Messick, 1985)

The Three Factor Eating Questionnaire was originally a 51-item scale that evaluated the psychological aspects of food intake, such as cognitive restraint (CR), uncontrolled eating (UE) and emotional eating (EmE). The reduced version of the questionnaire (TFEQ R-18) holds a simple 18-item scale, which in studies showed a larger replicability with a wider population rather than in only obese population (e.g. non-obese, adolescents, etc). (Karlsson, et al., 2000).

For the purpose of this study, the CR construct was included in the eating behavior questionnaire. This concept of “cognitive restraint” is a part of the restraint theory of
obesity, even though it has been shown to not be a particular aspect of only obese population. The answering method of the questionnaire is made by a response scale (definitely true/mostly true/mostly false/definitely false), which is as well scored into a 1-4 scale. (Lauzon, et al., 2004) Each construct is scored individually, and in this case with CR, this would mean that if a person gets a high cognitive restraint, the person has a way of consciously control of their food intake, restricting it, and not letting the physiological regulations to stop the intake. (Anglé, et al., 2009)
METHODS

STUDY DESIGN

The following study is a quantitative study, cross sectional, in leisure centers from the Circadian Trust, in the city of Bristol. The data collection started in June 15th, 2015 to July 19th, 2015. The study was structured in a 7 day period of time of data collection, involving: a physical activity evaluation through the use of accelerometers and a self-report exercise log; a dietary evaluation with the use of a food log application (myfitnesspal); and the evaluation of physical activity and eating behavior by the direct questionnaires. The study was approved by the Centre for Exercise, Nutrition and Health Sciences (CENHS) Ethics Committee: EAN 030-14

SAMPLE

Participants were recruited in Circadian Trust Leisure Centers in Kingswood and Bradley Stoke, with previous consent from management. Information about the study was personally delivered in the gym facilities before and after the fitness classes occurred in the centers, by handing out fliers and using posters with rip-off researcher contact information. People received an information sheet summarizing the purpose of the study if they showed interest in participating, and contact details were collected to obtain a consent in participating to schedule a subsequent meeting to explain and start the data collection.

Recruitment

As inclusion criteria, people between 19-60 years old, who took part in fitness classes in any of the mentioned leisure centers, with active and non-active days throughout any given week (in order to measure the food intake and possible compensation in physically active days), and that were willing to participate in the study were eligible for participation. Exclusion criteria included people who were actively involved in either weight loss or gain diets, co-morbidities associated with diet modification treatment and pregnancy (see Figure5).
From the 7 people who met the criteria in Bradley Stoke and 19 in Kingswood Leisure Centers, only 5 and 11 people participated from each. People who did not participate in the study did not respond to any contact method by the researcher for a subsequent meeting.

**DATA COLLECTION**

Once the participant signed an informed consent approving the use of information collected throughout the study, a participant ID was assigned to ensure anonymity in the data collected, and these were matched in a private and separate file with contact information, in order to
keep a security log for the equipment that would be provided to the participants. After assuring order and anonymity, measurements were gathered.

**Measurements**

Baseline and follow-up measures

At the beginning of the study and at the end of 7 days of data collection, anthropometrics measurements were gathered, that is, height, weight, body mass index (BMI) and fat percentage. These were measured by weight scales with bioelectrical impedance analysis and stadiometer borrowed from the ENHS (Exercise, Health and Nutrition Sciences), in the gym area.

Additional information about the participants were gathered at the beginning of the online questionnaires that the participants filled at the end of the study, such as age, gender and the ID of the participant, to link the responses to the participants.

**PHYSICAL ACTIVITY**

Accelerometer and exercise log

Physical activity was measured in two ways. Actigraph accelerometers 3GT3X+ were asked to be used in the right hip, for the 7 days from the moment the participants woke-up in the mornings to the moment they went to sleep at nights, with the exception of use while performing activities with water, thus, recording the intensity and total activity.

In free living people, the Actigraph 3GT3X+ has shown high levels of interinstrument reliability (Coefficient of variability [CV] 2.85 and interclass correlation [ICC] 0.99), showing that MVPA records are shown to be truthful to the actual physical activity performed. (Jarrett et al. 2015)

The second way was by keeping an exercise log on *myfitnesspal* which a method for identifying active and non-active days based on participant perception of having taken part in formal exercise rather than more broadly total levels of MVPA, and also to evaluate the perception of people with the amount of physical activity performed.
Physical Activity Questionnaire

Behavioural Regulation in Exercise Questionnaire (BREQ)

The BREQ-2 was applied to understand the behavioral responses and motivations of physical activity in the participants. (Markland & Tobin 2010) All four constructs that are measuring external regulation, introjected regulation, identified regulation and intrinsic regulation were included in the evaluation to get a complete view of what determines the participants to being physically active, and to later on correlate with the perceived physical activity the participants have introduced in their exercise log and their actual performance (confirmed by accelerometers). To answer, the questionnaire gives a 5-score scale 0 = “not true for me” to 4 = “very true for me.”

Each of the constructs or scales were added up, and then converted with the Relative Autonomy Index (RAI) proposed by Ryan and Connell (1989) or “Self-determination Index” to get one solid final score of the overall questionnaire. This score reflects the scale by which a person has more self-determined behavior to perform physical activity, or in other words, if external pressure or autonomous choice regulate a person from being physically active (Higher scores (+) indicate greater relative autonomy; lower scores (-) indicate more controlled regulation). (Moustaka et al. 2010)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>External regulation</td>
<td>-2</td>
</tr>
<tr>
<td>Introjected regulation</td>
<td>-1</td>
</tr>
<tr>
<td>Identified regulation</td>
<td>2</td>
</tr>
<tr>
<td>Intrinsic regulation</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 2. Relative Autonomy Index (RAI) for each construct to get a final score

Dietary Factors

Food log (myfitnesspal)

A food log was required to be filled out daily by the participants. By using the myfitnesspal application (which can be logged through computer or smartphone application) the quantification of food, along with its overall nutritional data required for the study (overall calorie, carbohydrate, protein and fat intake) was gathered.
Although this dietary application has not yet been used in other studies, or tested for reliability in the food database it is user friendly and has a ‘verified food’ list, where other users check the nutritional information to be accurate by double checking food labels directly from the food producer, by comparing to other entries from the same product. (Anon 2015) A training protocol and information sheet for participants to assure accurate data collection was provided. (Appendix5) At the end of the 7 days of data collection, participants were asked to download the printable diet report directly in a laptop with access to the student remote access of the university server, at the end of the assessment.

**Eating Behavior Questionnaires**

The questionnaire that was completed by the participant was a combination of the AEBQ and the TFEQ R-18, with a total of 30 questions from the eating behavior section. From the AEBQ, the constructs that were included in the study were food responsiveness, enjoyment of food, emotional over and undereating, and satiety responsiveness, with a total of 25 questions. To score this questionnaire, each construct was averaged individually to understand how each behavior interacted with food intake.

The TFEQ-R18 was used to complement the AEBQ. The construct applied in this section of the evaluation was the cognitive restraint which holds 5 questions. To score this section of the questionnaire, instructions suggested using the following calculation: 
\[
\text{score} = \frac{\text{raw score} - \text{lowest possible raw score}}{\text{possible raw score range}} \times 100
\]

The higher the score was, the more the intake is regulated by cognitive restraint.

At the end of the study, and on the same day the accelerometer was handed back in, this questionnaires were completed by the participants in order to analyze the motivations of food choice in the participant’s eating behavior.

**DATA PROCESSING**

**Physical activity**

Data from the accelerometers was downloaded and converted into 10 second epoch data; and processed with Kinesoft program, in which decisions were made to determine if the data was valid or not for the study. Non-wear time was defined as more than 60 minutes of consecutive zeros; cut points for the physical activity intensity were determined with Freedson cut points.
to catalogue as sedentary, light, moderate or vigorous intensity the activity recorded in the
devices using >1952 counts as MVPA. (FREEDSON et al. 1998) Valid times were set up
for 15 hours a day (7am – 10pm in weekdays and 8am – 11pm in weekends). And for the
intensity and wear time report, both were modified to be shown by hour of the day.

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Cut points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td>0 - 99 CPM</td>
</tr>
<tr>
<td>Light</td>
<td>100 - 1951 CPM</td>
</tr>
<tr>
<td>Moderate</td>
<td>1952 - 5724 CPM</td>
</tr>
<tr>
<td>Vigorous</td>
<td>5725 - 9498 CPM</td>
</tr>
<tr>
<td>Very Vigorous</td>
<td>&gt;9499 CPM</td>
</tr>
</tbody>
</table>

Table 3. Physical activity intensity cut points: Freedson 1998 used in Kinesoft

Active days were defined as days that completed more than 30 minutes of MVPA in the
accelerometer data, corresponding to the records in the exercise log.

MVPA and sedentary time was averaged in “minutes” time in weekdays and weekends, and
added up to get a total average from the 7 day study.

Dietary

Calculations of the estimated energy requirements (EER) per participant were made using
the following calculations:

<table>
<thead>
<tr>
<th>EER for Men Ages 19 Years and Older</th>
<th>EER for Women Ages 19 Years and Older</th>
</tr>
</thead>
<tbody>
<tr>
<td>EER = 662 – (9.53 x age [y]) + PA x (15.91 x weight [kg] + 539.6 x height [m])</td>
<td>EER = 354 – (6.91 x age [y]) + PA x (9.36 x weight [kg] + 726 x height [m])</td>
</tr>
</tbody>
</table>

Where PA is the physical activity coefficient:
PA = 1.00 if PAL is estimated to be ≥ 1.0 < 1.4 (sedentary)
PA = 1.11 if PAL is estimated to be ≥ 1.4 < 1.6 (low active)
PA = 1.25 if PAL is estimated to be ≥ 1.6 < 1.9 (active)
PA = 1.48 if PAL is estimated to be ≥ 1.9 < 2.5 (very active)

Table 4. Estimated Energy Requirements formulas (IOM (Institute of Medicine), 2005) EER:
With this results, the expected daily intake was determined per participant depending on the physical activity intensity and from this, the actual intake reported by the participants in the myfitnesspal application was compared to determine compensation.

Compensation was also evaluated by computing the daily differences of the logged calorie intake (kcal), and compared to the differences of MVPA between days (minutes).

The nutrients distribution (carbohydrates, fat, protein), was calculated to verify the quality of the intake from the reports of each nutrient in the food log. A calculation was made to convert it into percentage (%) and compare it with the recommended intake in weight maintenance guidelines. [TOTAL CH, FAT, PROTEIN IN GRAMS X 100 / “SPECIFIC NUTRIENT” (IN GRAMS)].

Calories were managed in the same way (in kcal consumption).

**Questionnaires**

Bristol Online Survey (BOS) was used to upload the questionnaires used for the behavioral analysis. At the completion by all the participants, the data was converted into a SPSS database to be able to score each section of the questionnaires and analyze with the other variables in study.

**DATA ANALYSIS**

**STATISTICAL ANALYSIS**

The statistical analysis was performed with IBM SPSS Statistics version 21. To apply any statistical analysis, normality was verified by using histograms with normality curve display. Descriptive analyses such as mean values, frequencies and standard deviations were made with age, gender and anthropometrics to get an overall view of the distribution of the sample in study.

Correlation between the physical activity and dietary variables were also performed, to analyze the factors that influence behaviors.

Analysis of Variance (ANOVA) was performed to analyze the differences in the MVPA performed and the calorie intake depending on BMI and fat percentage groups.

All results were based on a level of significance of $p<0.05$. 

35
RESULTS

Participants

From the Bradley Stoke Leisure Center, 5 participants were recruited for the study from 8 people who signed up; and from the Kingswood Leisure Center 11 were recruited from the 21 people that signed up. From this sample of 16 people, 15 were women and 1 was male. Because of the lack of male participants in the study, comparisons between groups in the analyses are not compared between genders, but was still considered in individual analysis of data.

The ranges of age were between 22 to 59 years old; and anthropometrics characteristics (BMI and fat percentage in categories) are shown in Table 5 and 6, having 11 people categorized as normal weight in BMI and 6 people in average fat percentage.

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>11</td>
<td>68.8</td>
</tr>
<tr>
<td>Overweight</td>
<td>3</td>
<td>18.8</td>
</tr>
<tr>
<td>Obese</td>
<td>2</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Table 5. Distribution of the sample according to BMI (Normal: <25, Overweight: 25-29.9, Obese: >30)

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athletes</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Fitness</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Average</td>
<td>6</td>
<td>37.5</td>
</tr>
<tr>
<td>Obese</td>
<td>2</td>
<td>12.5</td>
</tr>
</tbody>
</table>

Table 6. Distribution of the sample according to Fat percentage (Appendix 1)

In average adding up MVPA in weekdays and weekends the results show that participants are achieving a high MVPA during the week, apparently not reaching recommendations, according to UK PA guidelines for weight maintenance [total= 330.17 (SD=149.87) minutes per week]. (Table7) However, by individually analyzing the MVPA time per participant only one did not achieved the recommendations.
### Weekdays, Weekends, and Total

<table>
<thead>
<tr>
<th></th>
<th>Weekdays</th>
<th></th>
<th>Weekends</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td></td>
<td>Mean (SD)</td>
<td></td>
<td>Average (SD)</td>
</tr>
<tr>
<td>MVPA (mins)</td>
<td>259.16 (±110.78)</td>
<td></td>
<td>71.01 (±39.09)</td>
<td></td>
<td>330.17 (±149.87)</td>
</tr>
<tr>
<td>Sedentary time (mins)</td>
<td>2639.16 (±468.28)</td>
<td></td>
<td>937.58 (±209.24)</td>
<td></td>
<td>3576.74 (±677.52)</td>
</tr>
<tr>
<td>Calorie intake (kcal/5 weekdays)</td>
<td>1604.66 (±382)</td>
<td></td>
<td>1670 (±533.74)</td>
<td></td>
<td>3274.66 (±915.74)</td>
</tr>
</tbody>
</table>

Table 7. Averages of MVPA, sedentary time and caloric intake in weekdays and weekends. The table shows the average values of MVPA achieved and sedentary time in participants, in addition to a total count of the caloric intake. *Mins= minutes; Kcal=kilocalories; SD= Standard Deviation*

### Associations Between Variables

**BMI categories, Fat Percentage categories and Total MVPA time and Total caloric intake**

<table>
<thead>
<tr>
<th></th>
<th>Fat Percentage</th>
<th>Total MVPA</th>
<th>Total Calorie Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>0.481</td>
<td>-0.432</td>
<td>-0.025</td>
</tr>
<tr>
<td>Fat Percentage</td>
<td><strong>0.192</strong></td>
<td>0.192</td>
<td>-0.184</td>
</tr>
</tbody>
</table>

Table 8. Correlations between BMI and Fat percentage categories with Total MVPA and caloric intake (*p<0.05  **p<0.01*)

The relationship between the MVPA with the amount of sedentary time both in weekends, reported to have a positive relationship, meaning that the more active they were on weekends, the more sedentary the participants were as well with a medium correlation ($r=0.5$ $p=0.045$) (Table 8). MVPA in weekdays and weekends were positively associated: the more activity performed in weekdays, the more they also did on weekends ($r= 0.53$ $p=0.034$.)

Data shows how the amount of time the participants performed MVPA in weekends was inversely related to sedentary time in weekdays, meaning that the more MVPA done, the less time they spent being sedentary in a $r=0.5$, or the contraire, the more time they spent by being sedentary at the weekend, the less MVPA they achieved during weekdays, however, this was not statistically significant.
Physical activity intensity and Caloric intake

Total amount of time of MVPA in weekdays and weekends was compared with the total amount of caloric intake in weekdays and weekends. Data showed a negative correlation between the amount of MVPA in the weekdays with the caloric intake in the weekends, with a less chance for the participants who have achieved MVPA in the weekdays to consume less calories in the weekends ($r=-0.608 \ p=0.012$). MVPA in the weekends had no significant influence in the caloric intake through the entire week. Caloric intake in the weekdays reflected to have a linear association with the caloric intake in the weekends ($r=0.68 \ p=0.05$). (Table 10)
Cognitive restraint (TFEQ) and Caloric intake

Statistical analysis showed that a more cognitive restraint was correlated to a 61% chance of consuming less calories in the weekdays only. Although in a similar direction but of smaller magnitude there was no statistically significant correlation was found with weekends.

<table>
<thead>
<tr>
<th>TFEQ</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Caloric intake in weekdays</td>
<td>r -0.610*</td>
</tr>
<tr>
<td>Caloric intake in weekends</td>
<td>r -0.436</td>
</tr>
</tbody>
</table>

Table 11. Correlation between the cognitive restrained measured in the TFEQ and the caloric intake in weekdays and weekends. (TFEQ= Three Factor Eating Questionnaire) (*p<0.05   **p<0.01)

AEBQ and caloric intake

<table>
<thead>
<tr>
<th></th>
<th>SR</th>
<th>EF</th>
<th>EOE</th>
<th>EUE</th>
<th>H</th>
<th>FR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy intake</td>
<td>r 0.045</td>
<td>0.120</td>
<td>-0.360</td>
<td>0.388</td>
<td>0.160</td>
<td>0.079</td>
</tr>
<tr>
<td>SR</td>
<td>r -0.267</td>
<td>-0.301</td>
<td>0.415</td>
<td>-0.124</td>
<td>-0.318</td>
<td></td>
</tr>
<tr>
<td>EF</td>
<td>r 0.279</td>
<td>0.015</td>
<td>0.415</td>
<td>0.042</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EOE</td>
<td>r -0.579*</td>
<td>0.260</td>
<td>0.163</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUE</td>
<td>r 0.077</td>
<td>-0.208</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>r</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.170</td>
</tr>
</tbody>
</table>

Table 12. Correlations of AEBQ constructs with total caloric intake (*p<0.05   **p<0.01)

SR= Satiety Response; EF= Enjoyment of Food; EOE= Emotional Over Eating; EUE= Emotional under Eating; H= Hunger; FR= Food Responsiveness

Table 12 shows the associations between the AEBQ and the caloric intake. None of the constructs separately show any association between each other or between the amounts of calorie intake consumed. Only EOE and EUE showed inverse correlations between each other (r= -0.579 p=0.019).

BREQ-2 and MVPA

An inverse correlation is found between the higher scores in BREQ-2 with the amount of MVPA in the weekends, meaning that with a higher score in the BREQ-2, the lower MVPA is in this sample.
Table 13. Correlations between BREQ-2 and MVPA time in weekdays and weekends. Table 6 shows the correlation between the score in the BREQ-2 in comparison with the amount of MVPA performed in the weekdays and weekends.

**BREQ-2** = Behavioural Regulation in Exercise Questionnaire

<table>
<thead>
<tr>
<th>BREQ-2</th>
<th>MVPA in weekdays</th>
<th>MVPA in weekends</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>0.103</td>
<td>-0.527*</td>
</tr>
</tbody>
</table>

*Nutrients consumed and nutrients required*

Overall, none of the participants complied with the recommended distribution of nutrients (carbohydrates, fat and protein). (IOM (Institute of Medicine) 2005) in comparison to the recommended values, carbohydrates consumption was higher, proteins were lower, and fats were even lower than recommendations. Regarding individual nutrients associations, carbohydrates consumption show an inverse relationship with protein consumption ($r= -0.615 p=0.011$) (Table 14)

Table 14. Correlations between the differences found in nutrients (expected-consumed)

<table>
<thead>
<tr>
<th></th>
<th>Total fat difference (%)</th>
<th>Total protein difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CH difference (%)</td>
<td>$r$</td>
<td>-0.462</td>
</tr>
<tr>
<td>Total fat difference (%)</td>
<td>$r$</td>
<td><strong>-0.227</strong></td>
</tr>
</tbody>
</table>
Caloric intake and compensation

The expected calorie intake was calculated by getting the difference of the estimated energy intake minus the actual intake of the participants. In most days, participants did not reach the estimated energy requirements (EER). With this result, calorie intake was calculated in non-physically active days and active days, showing active to be slightly higher than in non-active days. (Table 15). Appendix 6 shows graphs with the calorie intake in each participant in active and non-active days.

<table>
<thead>
<tr>
<th>Participant</th>
<th>CH %</th>
<th>FAT %</th>
<th>PROTEIN %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42.8</td>
<td>69.63</td>
<td>10.22</td>
</tr>
<tr>
<td>3</td>
<td>26.6</td>
<td>63.16</td>
<td>10.25</td>
</tr>
<tr>
<td>4</td>
<td>54.3</td>
<td>63.52</td>
<td>10.93</td>
</tr>
<tr>
<td>5</td>
<td>35.3</td>
<td>50.89</td>
<td>10.41</td>
</tr>
<tr>
<td>6</td>
<td>205</td>
<td>64.39</td>
<td>22.44</td>
</tr>
<tr>
<td>7</td>
<td>159</td>
<td>55.97</td>
<td>35.72</td>
</tr>
<tr>
<td>8</td>
<td>273</td>
<td>44.89</td>
<td>35.88</td>
</tr>
<tr>
<td>9</td>
<td>185</td>
<td>67.79</td>
<td>5.83</td>
</tr>
<tr>
<td>10</td>
<td>159</td>
<td>71.43</td>
<td>10.92</td>
</tr>
<tr>
<td>11</td>
<td>379</td>
<td>35.81</td>
<td>16.22</td>
</tr>
<tr>
<td>12</td>
<td>352</td>
<td>64.10</td>
<td>19.89</td>
</tr>
<tr>
<td>13</td>
<td>509</td>
<td>59.80</td>
<td>14.05</td>
</tr>
<tr>
<td>14</td>
<td>432</td>
<td>62.27</td>
<td>17.76</td>
</tr>
<tr>
<td>15</td>
<td>427</td>
<td>55.21</td>
<td>26.46</td>
</tr>
<tr>
<td>16</td>
<td>333</td>
<td>69.07</td>
<td>12.32</td>
</tr>
<tr>
<td>17</td>
<td>409</td>
<td>25.67</td>
<td>60.39</td>
</tr>
</tbody>
</table>

Figure 6. Nutrients calculation per participant

<table>
<thead>
<tr>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorie intake in Non-active days</td>
</tr>
<tr>
<td>Calorie intake in active days</td>
</tr>
</tbody>
</table>

Table 15. Mean values of calories intake in active and non-active days

Correlations between MVPA in weekdays with the average caloric intake consumption in weekdays and weekends were all positive, as seen in Table 10. This means that the more
MVPA is performed during the weekdays, less calories the participants had on intake (more positive balance in the difference).

The correlations with weekday caloric intake with the MVPA performed on weekends was the only correlation with no actual significance.

<table>
<thead>
<tr>
<th></th>
<th>Average difference in caloric intake (weekends)</th>
<th>MVPA weekdays</th>
<th>MVPA weekends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average difference in caloric intake (weekdays)</td>
<td>r 0.860**</td>
<td>0.648**</td>
<td>0.167</td>
</tr>
<tr>
<td>Average difference in caloric intake (weekends)</td>
<td>r</td>
<td>0.778**</td>
<td>0.310</td>
</tr>
<tr>
<td>MVPA weekdays</td>
<td>r</td>
<td>0.533*</td>
<td></td>
</tr>
</tbody>
</table>

Table 16. Correlation between the average difference of caloric intake in weekdays and weekends and MVPA (*p<0.05   **p<0.01)

Differences between days in calorie intake and in amount of MVPA were analyzed, which showed no correlations between each other. These were correlated when divided into the type of activity that was performed in the days were difference was gotten (active-active, active-non active, non active-non active and non active-non active), and still no correlations were found between MVPA and calorie intake. In addition to this, linear regression was performed, showing no other correlations between the questionnaires constructs.

<table>
<thead>
<tr>
<th></th>
<th>Mean value (Min-max)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorie Intake Difference (%)</td>
<td>-3.92 (-125.26 to 53.91)</td>
<td>29.5</td>
</tr>
</tbody>
</table>

Table 17. Average between-days differences of calorie intake

Descriptive statistics showed participants had an average tendency of decreasing their calorie intake between days, with a mean value of 3.92% (Table17). Each table of mean differences per participant is shown in appendix7. Participant 12 was excluded from this analysis as intake values were missing in day 1.
DIFFERENCES BETWEEN BMI AND FAT PERCENTAGE CATEGORIES

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>Mean square</th>
<th>F (sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Calorie Intake</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>2</td>
<td>6767957.550</td>
<td>0.859 (0.448)</td>
</tr>
<tr>
<td>Within Groups</td>
<td>12</td>
<td>7882053.075</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total MVPA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>2</td>
<td>35850.956</td>
<td>2.279 (0.142)</td>
</tr>
<tr>
<td>Within Groups</td>
<td>13</td>
<td>15731.554</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 18. ANOVA between BMI categories, total calorie intake and MVPA

Table 18 shows ANOVA between BMI categories and total calorie intake, and BMI categories and total MVPA respectively. Neither of the variables presented any differences between or within the groups (F=0.859 sig. 0.448 and F=2.279 sig. 0.142).

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>Mean square</th>
<th>F (sig.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Calorie Intake</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>6859293.100</td>
<td>0.862 (0.490)</td>
</tr>
<tr>
<td>Within Groups</td>
<td>11</td>
<td>7968424.791</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total MVPA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>2</td>
<td>19231.467</td>
<td>1.056 (0.404)</td>
</tr>
<tr>
<td>Within Groups</td>
<td>13</td>
<td>18208.809</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 19. ANOVA between fat percentage categories, total calorie intake and total MVPA.

Table 19 shows ANOVA between fat percentage categories and total calorie intake, and fat percentage categories and total MVPA respectively. Neither of the variables presented any differences between or within the groups (F=0.862 sig. 0.490 and F=1.056 sig. 0.404).

MEAL AND SNACK CONTRIBUTIONS TO ENERGY INTAKE ON ACTIVE AND NON-ACTIVE DAYS

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast (%)</td>
<td>17.95 (6.05-42.36)</td>
<td>9.17</td>
</tr>
<tr>
<td>Lunch (%)</td>
<td>22.78 (6.5-33.85 )</td>
<td>7.05</td>
</tr>
<tr>
<td>Dinner (%)</td>
<td>35.33 (23.72-56.09 )</td>
<td>7.51</td>
</tr>
<tr>
<td>Snacks (%)</td>
<td>21.72 (0-43.05)</td>
<td>11.25</td>
</tr>
</tbody>
</table>

Table 20. Calorie intake classification per meal and snacks on a week – Frequencies (%)

Total energy intake was classified as frequencies per meal (breakfast, lunch and dinner), added with the snacks representation in frequencies additionally. Overall the 7 days, and in
all participants, the highest data corresponds to dinner with a 36.14% of the total intake followed by lunch (23.31%), snacks (22.03%) and breakfast (16.97%).

<table>
<thead>
<tr>
<th></th>
<th>ACTIVE DAYS</th>
<th></th>
<th>NON-ACTIVE DAYS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Breakfast (%)</td>
<td>17.56</td>
<td>9.09</td>
<td>Breakfast (%)</td>
<td>18.59</td>
</tr>
<tr>
<td>Lunch (%)</td>
<td>24.73</td>
<td>7.09</td>
<td>Lunch (%)</td>
<td>22.47</td>
</tr>
<tr>
<td>Dinner (%)</td>
<td>39.50</td>
<td>7.5</td>
<td>Dinner (%)</td>
<td>35.30</td>
</tr>
<tr>
<td>Snacks (%)</td>
<td>24.11</td>
<td>11.32</td>
<td>Snacks (%)</td>
<td>21.25</td>
</tr>
</tbody>
</table>

Table 21. Calorie intake classification per meal and snacks on active and non-active days – Frequencies (%)

The total energy intake was divided into active and non-active days to give a better perspective of the contributions of each meal and snacks to the diet. Table 21 shows how the tendency found in the overall mean values is repeated having dinner as the highest percentage of input, lunch, snacks and breakfast follow it.
DISCUSSION

MAIN OUTCOMES
The study aimed to measure the amount of calorie intake compensation due to physical activity, as well with the possible determinants of behavior in food intake and PA individually.

Dietary outcomes

Compensation The main outcomes that were found, and answering the main research question, was the lack of intake compensation in people who are normally physically active by comparing the active and non-active days. This means that people do not tend to eat more even if their energy expenditure is high due to physical activity. However, people in average tend to have a higher calorie intake in the active days compared to the non-active days. All of these could be due for a number of reasons. For example, people were in a free-living environment which could lead to difficulties in accurately getting dietary data. For these measurements, myfitnesspal was used for the data collection. Most of the people were already familiarized with the application, but others were just starting with its use, which may affected the log, especially with the food logging for not knowing portions. This may be one of the reasons participants could enter inaccurate calorie intake, interfering with the evaluation of the measure for compensation. It is important to mention that even though food diaries are known to be fairly tools for dietary input, there may be an under-estimation or the amount of food consumed, as people tend to under-size their intake. (Gemming et al. 2014) In addition, this specific application has not yet been validated for these types of studies. Nonetheless, other nutritional apps have been used and validated before, showing a well adaptability and response from the users (probably due to the ability to be completed at any moment and not consuming long periods). (Wharton et al. 2014) Myfitnesspal was applied in the study because it is user-friendly, it is available in a smartphone or online via website, and because of the vast food database available there. The studies that have evaluated compensation in energy intake have not used this type of measurement tool, but other direct measures such as weighted foods or controlled menu to have accurate-exact data (Riou et al. 2015; George & Morganstein 2003; Pomerleau
et al. 2004) so this would be one study, according to profound research, to use this application in particular.

Finally, the overall calorie consumption results showed a positive correlation with food consumption in weekdays and weekends. Possible explanations for this correlation could be that people tend to follow a regular pattern, having specific food preferences that reflect on grocery shopping behavior. All of this results in having a balanced and consistent calorie intake, evidenced in the data analysis.

**BMI, Fat percentage and calorie intake** No correlations were found between BMI and fat percentage in relation to energy intake. No differences were found in the study between the categories pf BMI and fat percentage in the participants in relation to the calorie intake. This may contradict some studies, such as Stubbs et al where not only intake differed, but also compensation was found in the groups with higher BMI when being physically active. Our results could probably due to the limited sample, were most of the participants were in a normal BMI category and average fat percentage category; and the possible limited recruitment conditions required in the study (people already enlisted in a leisure center and that currently assisted fitness classes).

**Questionnaires** When comparing the calorie intake with cognitive restraint, an inverse correlation was found which means that people who tend to have a higher cognitive restraint may eat less. This would mean that people might be consciously controlling their food intake, thus eating less, when MVPA is higher. Similar results were found by Lauzon et al where weight loss was measured and correlated to the level of cognitive response with the TFEQ; higher restraint meant less weight gain, or higher weight loss. (de Lauzon et al. 2004) One explanation may be due to the sample being based more on women population, in whom cognitive restraint seems to be more accentuated. Another reason could be because these samples are based on normally physically active people who might have already gotten used to control their intake to auto-regulate their weight. (Van Loan & Keim 2000) However, the calorie intake was not correlated by satiety response, enjoyment of food, emotions or by food responsiveness according to the added scores in the participants. Possible explanations could be: that food composition may influence the response to satiety; that lack of correlation is present in enjoyment (due to the knowledge that more food may be associated to extra calories); or even that these complete lack of correlations in the AEBQ was due to the sample size.
Carbohydrates, Protein and Fat  

Nutrients were calculated to evaluate the quality of the food intake, in which the results showed a lower consumption of fat and carbohydrates that expected (IOM (Institute of Medicine) 2005), in addition to an inverse correlation between the consumption of carbohydrates and proteins. It could be speculated that this is probably due to some recommendations for weight loss, were people tend to increase protein to gain muscle mass and lower the consumption of carbohydrates to control weight. (Noakes et al. 2005) It is still unforeseen that even when carbohydrates and fat are reduced in the diet, no modifications are found in protein intake, where normally protein intake tends to increase, especially if it is in normally physically active people.

Meals and snacks  

Overall, and analyzing the data by active and non-active days, the patterns or how much a meal and snack represents in the day (and week) is the same, being the most part from dinner, followed by the lunch, snacks and finally breakfast. In a cross-sectional study by Kant et al with a health survey database, a similar pattern of representation of the meals was also obtained. (Kant & Graubard 2015) However, snacks consumption was higher than expected in comparison to breakfast. It could be assumed that this pattern of energy consumption might be to working hours or cooking time that may delay a proper meal consumption.

Physical activity outcomes  

For the physical activity, the use of accelerometers as an observational tool has proven to be reliable and sensitive on the data collected. Still the method was ideal because of the non-controlled environment, in free-living individuals, which required non-invasive and easy carry-on method to be able to attend to work, and that could still be reliable on data results instead of only self-reported exercise logs. (Lee & Shiroma 2014; McClain et al. 2007)

Meeting the recommendations  

MVPA recommendations were achieved by all the participants in most of the days, and by comparing the total amount in minutes per week, all of the participants went along with the UK physical activity guidelines for weight maintenance (NICE 2015), with the exception on one participant who completed less than 150 minutes in the week of study. It is important to bear in mind that participants were recruited from fitness classes, and all were already involved in physical activity routines, or had already created an active habit, which allowed them to meet the recommendations. This
could ratify the usefulness of having leisure centers installed in populated areas, accessible for people in age ranges, and with physical activity preferences. Sedentary time was still high in participants, and correlated positively with the average amount of physical activity per week. This could mean that people who are active may want to increment their periods or resting time. Another interpretation of this result is that people who are not achieving a high activity may want to lessen the resting time, to compensate the lack of exercise.

**MVPA and calorie intake** In the association analysis, the findings showed that more physical activity performed during the weekdays meant less calorie intake in the weekends. This was not shown in the average values of calorie intake by comparing active and non-active days, which were similar amongst each other, with a slight higher average in active days. This could be due to the body’s own physiological regulatory mechanisms, requiring more energy after PA, showing an apparent higher calorie count; or because of the energy balance required to equilibrate the energy expended with energy intake. This results are consistent to previous studies that also suggest that physical activity does not induce a higher energy intake (calorie intake), such as Donnelly et al who proposed that the energy consumption post-exercise is only partial to the total amount of energy expended in exercise. (Donnelly et al. 2014)

**BREQ-2 and MVPA** The associations in this study with the BREQ-2 questionnaire showed that a higher score, the more MVPA was performed by participants. Higher scores in the BREQ-2 show a lower effect of external perception over being physically active. This would mean that people might be achieving MVPA due to personal or health related reasons, more than an external appearance.

**BMI, Fat percentage and MVPA** the results of the study showed that there were no differences between the different categories of BMI and fat percentage in relation with the amount of MVPA performed. No correlations were found either with the total amount of MVPA. These results are not consistent to current literature, where it is shown that people with higher fat percentage, or are obese, tend to present lower MVPA time; an example is Maher et al, who found positive associations in a cross-sectional study with the US National Health and Nutrition Examination Survey (NHANES) data from 2003-2005 in an obese sample. (Maher et al. 2013)
STRENGTHS AND LIMITATIONS

One of the strengths of the study was the availability to collect data from leisure centers with a high number of people who attend to fitness classes. This allowed having a less complex recruitment process, with the collaboration of the management and fitness instructors for the promotion of the study. This also permitted the recruitment of a fairly homogenous sample to get more accurate results that reflect to the population.

Another strength may be the use of smartphones apps, in this case, myfitnesspal to facilitate data collection, and allow the “free-living” condition of the participant to be fully respected. Being the first time known to use this particular nutritional app, could allow more studies to be focused on its validation for posterior researches. Still, most of the participants were already familiarized with the application, thus, making the record of their intake easier.

One of the limitations found in the sample of study, was that some participants were involved in cycling -classes or as active commuting- or as extra activities also swimming, which is shown to have a lower sensitivity for measuring counts with the accelerometer device, accurately. This same limitation would affect in the measure of strength training and Yoga classes that were also performed. In addition to these, participants forgot to wear the accelerometer for periods of time, but still, were able to be included at the moment of processing data, for they complied with the inclusion criteria.

Another weakness was the limited sample that was gathered. The number of participants that was expected in the recruitment process was not achieved. This was probably due to the data gathering processes that was required in participants, such as using myfitnesspal which meant time consumption and the use of the accelerometers which meant its use for 7 days and the use with clothes in free-time.

Another limitation was the probable bias by only recruiting people involved in fitness classes, which could limit the generalization process of the results that were obtained. This was tried to be avoided by the selection of two settings of leisure centers, to get a broader sample and from different areas; and by including people that not only participated in fitness classes but along with them, also did other activities such as active commuting or attended to gym sessions with strength training.

One of the main limitations as well, was the lack of male participants in the study, from which only one person decided to start with the study. The classes that were available were Zumba classes, cycling, Yoga, Circuits, Fitball, Body conditioning, Aerobics, TRX and functional fitness. From these, men only attended to cycling, aerobics and circuits classes.
CONCLUSIONS

The main outcome of this study was the lack of compensatory habits in physically active people who regularly attend to fitness classes. Although it was expected to obtain higher differences in the calorie intake on active days, an opposed result was found, which means the intake was similar in between days. Which reflected in the total calorie intake average, were a higher value, although minimum, was obtained in active days.
The distribution of intake in meals was predominant in dinner, but it is important to recall that snacks (although not precisely considered as meal) withholds a large calorie intake proportion. This data was consistent in both active and non-active days.

Through the TFEQ, cognitive restraint was found as one of the main influences under food choice and consumption in eating behavior. However, the AEBQ showed no correlations with food intake.

MVPA was achieved in most of the participants, with a weekly average of 330 minutes of MVPA, completing more than double of the recommendation time.
Physical activity associations found how people who tend to have a higher level of physical activity may have a higher level of autonomous behavior which translates to a lower effect over external perception when choosing to be physically active.

Additional work with a broader sample is needed to better understand the relationships between intake and physical activity. It is recommended that more studies focus on validation of useful measuring tools such as smartphones apps (myfitnesspal), to facilitate data collection in free-living population studies.
REFERENCES


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APPENDICES

Appendix1.  a) Jackson and Pollock (1978) fat percentage for men and women; b) ACE (American Council on Exercise) categorization of fat percentage.

APPENDICES

Appendix1.  a) Jackson and Pollock (1978) fat percentage for men and women; b) ACE (American Council on Exercise) categorization of fat percentage.

Appendix2. BREQ-2

WHY DO YOU ENGAGE IN EXERCISE?
Using the scale below, please indicate to what extent each of the following items is true for you.

<table>
<thead>
<tr>
<th>Category</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Fat</td>
<td>2-5%</td>
<td>10-13%</td>
</tr>
<tr>
<td>Athletes</td>
<td>6-13%</td>
<td>14-20%</td>
</tr>
<tr>
<td>Fitness</td>
<td>14-17%</td>
<td>21-24%</td>
</tr>
<tr>
<td>Average</td>
<td>18-24%</td>
<td>25-31%</td>
</tr>
<tr>
<td>Obese</td>
<td>25%</td>
<td>32%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not true for me</th>
<th>Sometimes true for me</th>
<th>Very true for me</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I exercise because other people say I should</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2 I feel guilty when I don’t exercise</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
3 I value the benefits of exercise 0 1 2 3 4
4 I exercise because it’s fun 0 1 2 3 4
6 I take part in exercise because my friends/family/partner say I should 0 1 2 3 4
7 I feel ashamed when I miss an exercise session 0 1 2 3 4
8 It’s important to me to exercise regularly 0 1 2 3 4

10 I enjoy my exercise sessions 0 1 2 3 4
11 I exercise because others will not be pleased with me if I don’t 0 1 2 3 4
13 I feel like a failure when I haven’t exercised in a while 0 1 2 3 4
14 I think it is important to make the effort to exercise regularly 0 1 2 3 4
15 I find exercise a pleasurable activity 0 1 2 3 4
16 I feel under pressure from my friends/family to exercise 0 1 2 3 4
17 I get restless if I don’t exercise regularly 0 1 2 3 4
18 I get pleasure and satisfaction from participating in exercise 0 1 2 3 4

**Appendix 3. AEBQ**

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I love food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat less when I’m worried</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat more when I’m anxious</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Given the choice, I would eat most of the time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I eat less when I’m angry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

58
### Appendix 4. TFEQ R-18 (Cognitive Restraint construct)

1. I deliberately take small helpings as a means of controlling my weight.
   
   *Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)*

2. I consciously hold back at meals in order not to weight gain.
   
   *Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)*

3. I do not eat some foods because they make me fat.
   
   *Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)*

4. How likely are you to consciously eat less than you want?
   
   *Unlikely (1)/ slightly likely (2)/ moderately likely (3)/ very likely (4)*

5. Do you go on eating binges though you are not hungry?
   
   *Never (1)/ rarely (2)/ sometimes (3)/ at least once a week (4)*

6. On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never “giving in”), what number would you give yourself?
Appendix 5. MyFitnessPal instructions

Getting Started With MyFitnessPal

- First, register with the site. Input all the information required on the registration page, upon which you’ll then be asked to fill out your own profile.

You can make this as detailed as you wish, keeping any information you prefer private.

- Next, you’ll need to input your stats.
- Go under ‘settings’ at the top of the page and then click on ‘Update Diet/Fitness Profile’.

You’ll then be taken to a page that will ask you to input factors such as your current weight, goal weight, height, gender, date of birth, activity level, exercise frequency, and so on to build your complete profile.

- From here, click on Goals and you will be brought to a page that illustrates how many calories you should be aiming for a day along with your carb, fat, and protein breakdown for optimal results.

### Your Fitness Goals

<table>
<thead>
<tr>
<th>Nutritional Goals</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Calories Consumed* / Day</td>
<td>1,640 cal/day</td>
</tr>
<tr>
<td>Carbs / Day</td>
<td>228.0 g</td>
</tr>
<tr>
<td>Fat / Day</td>
<td>55.0 g</td>
</tr>
<tr>
<td>Protein / Day</td>
<td>62.0 g</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fitness Goals</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories Burned / Week</td>
<td>0 cal/week</td>
</tr>
<tr>
<td>Workouts / Week</td>
<td>0 Workouts</td>
</tr>
<tr>
<td>Minutes / Workout</td>
<td>0 mins</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Your Diet Profile</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories Burned</td>
<td></td>
</tr>
<tr>
<td>From Normal Daily Activity</td>
<td>1,620 cal/day</td>
</tr>
<tr>
<td>Net Calories Consumed*</td>
<td></td>
</tr>
<tr>
<td>Your Daily Goal</td>
<td>1,640 cal/day</td>
</tr>
<tr>
<td>Daily Calorie Deficit</td>
<td>-20 calories</td>
</tr>
<tr>
<td>Projected Weight Loss</td>
<td>0 lbs/week</td>
</tr>
</tbody>
</table>

* Net Calories Consumed = Total Calories Consumed - Exercise Calories Burned

NOW YOU ARE READY TO START USING THE SITE.

Entering Your Food Intake

The very first step to start taking is to begin entering your food in the website.

- To begin, click on the ‘food’ tab at the top of the page.

From there, you’ll be brought to a section that shows your food diary for the current day of the week, breaking it up into breakfast lunch, as well as dinner.
To enter your breakfast meal, click on ‘add food’. Note that if you are eating the same breakfast from yesterday or already know the calories, you can click under ‘quick tools’ and simply hit quick add calories, copy yesterday, or copy from another date you may have had the same meal. This makes it easier if you typically eat similar meals throughout the course of the week.

If you are entering a new meal, after clicking add food, you will be taken to a new page where you can enter the food in question:

- Type in the food, trying to be as specific as possible. Let’s say you had an apple. After entering the query, you’re then brought to a list of matching foods of all varieties. Select the one that best matches your description. As you do this, one right hand side you’ll see another box that pops up that will then list the number of servings and how much each serving is
This part is very important. Enter the accurate amount of servings and then this food will then get added to the daily total.

Continue on doing this until your entire meal is entered and you will now see the total value of what you had to eat.

This process needs to be repeated for every meal and even if you ate something as a snack (there’s also the option snack). The diary should be completed in the 7 days.

You can also download the smartphone app, which will remind you whenever you forget to add any meal.

TRY to be as ACCURATE and TRUTHFUL as possible. Remember all the information is anonymous.
Appendix 6. Calorie Intake per participant according to active and non-active days

**Participant 1**

<table>
<thead>
<tr>
<th>Days</th>
<th>Calorie Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

**Participant 3**

<table>
<thead>
<tr>
<th>Days</th>
<th>Calorie Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
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<td>4</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>
### Participant 21

<table>
<thead>
<tr>
<th>Days</th>
<th>Calorie Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,500</td>
</tr>
<tr>
<td>2</td>
<td>1,500</td>
</tr>
<tr>
<td>3</td>
<td>1,500</td>
</tr>
<tr>
<td>4</td>
<td>1,500</td>
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<tr>
<td>5</td>
<td>1,500</td>
</tr>
<tr>
<td>6</td>
<td>2,000</td>
</tr>
<tr>
<td>7</td>
<td>2,000</td>
</tr>
</tbody>
</table>

### Participant 22

<table>
<thead>
<tr>
<th>Days</th>
<th>Calorie Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>1,500</td>
</tr>
<tr>
<td>3</td>
<td>1,500</td>
</tr>
<tr>
<td>4</td>
<td>1,500</td>
</tr>
<tr>
<td>5</td>
<td>2,000</td>
</tr>
<tr>
<td>6</td>
<td>2,000</td>
</tr>
<tr>
<td>7</td>
<td>2,000</td>
</tr>
</tbody>
</table>

### Participant 24

<table>
<thead>
<tr>
<th>Days</th>
<th>Calorie Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,500</td>
</tr>
<tr>
<td>2</td>
<td>1,500</td>
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<tr>
<td>3</td>
<td>1,500</td>
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<tr>
<td>4</td>
<td>1,500</td>
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<tr>
<td>5</td>
<td>2,000</td>
</tr>
<tr>
<td>6</td>
<td>2,000</td>
</tr>
<tr>
<td>7</td>
<td>2,000</td>
</tr>
</tbody>
</table>
Appendix 7. Between-day calorie intake differences (%) from each participant
BUILDING CHARTS

Differences in energy intake in participants:

* Chart Builder.
GGRAPH
/GRAPHDATASET NAME="graphdataset" VARIABLES=PARTICIPANT MEAN(ENERGYINTAKE)[name="MEAN_ENERGYINTAKE"] MISSING=LISTWISE REPORTMISSING=NO
/GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id("graphdataset"))
  DATA: PARTICIPANT=col(source(s), name("PARTICIPANT"), unit.category())
  DATA: MEAN_ENERGYINTAKE=col(source(s), name("MEAN_ENERGYINTAKE"))
  GUIDE: axis(dim(1), label("PARTICIPANT"))
  GUIDE: axis(dim(2), label("Mean ENERGYINTAKE"))
  SCALE: linear(dim(2), include(0))
  ELEMENT: line(position(PARTICIPANT*MEAN_ENERGYINTAKE), missing.wings())
END GPL.

Descriptive Analysis

Fat percentage and BMI frequency, mean values, SD

DESCRIPTIVES VARIABLES=Age FatPerc BMI
/STATISTICS=MEAN STDDEV MIN MAX.

Calculation of Difference in calorie intake per day

DATASET ACTIVATE DataSet1.
COMPUTE DifferenceIntakeMonday=EXPMONDAY - CONSMONDAY.
COMPUTE DifferenceIntakeTuesday=EXPTUESDAY - CONSTUESDAY.
COMPUTE DifferenceIntakeWednesday=EXPWEDNESDAY - CONSWEDNESDAY.
COMPUTE DifferenceIntakeThursday=EXPTHURSDAY - CONSTHURDAY.
COMPUTE DifferenceIntakeFriday=EXPFRIDAY - CONSFRIDAY.
COMPUTE DifferenceIntakeSaturday=EXPSATURDAY - CONSSATURDAY.
COMPUTE DifferenceIntakeSunday=EXPSUNDAY - CONSSUNDAY.
EXECUTE.
MVPA, Calorie intake and Active and non-active days

CORRELATIONS
/VARIABLES=Calorie Activity MVPA
/PRINT=TWOTAIL NOSIG

Total MVPA and BREQ-2

CORRELATIONS
/VARIABLES=BREQ2 TotalMPVA
/PRINT=TWOTAIL NOSIG
/MISSING=PAIRWISE.

Total calorie intake with AEBQ and TFEQ

DATASET ACTIVATE DataSet2.
CORRELATIONS
/VARIABLES=TFEQ TotalCal EF EOE EUE H SR FR
/PRINT=TWOTAIL NOSIG
/MISSING=PAIRWISE.

ANOVA between Fat Percentage and BMI with Total energy intake
MVPA normality curve

Active and non-active days database
Frequencies of the Fat Percentage and BMI categories in the sample
Statement of compliance with data protection procedures
PLEASE COMPLETE BY HAND

Title of dissertation: __________________________________________________________
__________________________________________________________________________
Student name:__________________________________________________________
Year/month of dissertation submission: ______ / ________
Ethics approval no: ________________________________

Procedures for destroying audio tapes or digital recording files

<table>
<thead>
<tr>
<th>No of recording sessions</th>
<th>No of tapes /digital files used in recording</th>
<th>Number of these destroyed:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Destruction procedure:
Witnessed by (sign):
Number of these erased*:
Erasure procedure:
Witnessed by (sign):

Comments:

Procedures for destroying video tapes

<table>
<thead>
<tr>
<th>No of recording sessions</th>
<th>No of tapes /digital files used in recording</th>
<th>Number of these destroyed:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Destruction procedure:
Witnessed by (sign):
Number of these erased*:
Erasure procedure:
Witnessed by (sign):

Comments:

I confirm that this is a true record of my procedures
Student signature: ________________________ Date: _____________

*The number of tapes/files destroyed PLUS those erased must equal the total number of interviews/recordings.
Record of Meeting with Adviser

Student Name: Romina Costa Beltran  
Year of submission: 2015

Dissertation title: Dietary preferences and compensatory dietary habits related to level of physical activity, Body Mass Index and body fat

<table>
<thead>
<tr>
<th>Meeting no</th>
<th>Date of meeting</th>
<th>Purpose(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9/04/2015</td>
<td>Introduction to dissertation</td>
</tr>
<tr>
<td>2</td>
<td>16/04/2015</td>
<td>Ethics Form Submission</td>
</tr>
<tr>
<td>3</td>
<td>6/05/2015</td>
<td>Protocol review and feedback</td>
</tr>
<tr>
<td>4</td>
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<td>Lit Review and Methods</td>
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<tr>
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<td>Data – analysis - SPSS</td>
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<td>8</td>
<td>28/08/2015</td>
<td>Results and dissertation formatting</td>
</tr>
</tbody>
</table>

I confirm this is a true record of the meetings with my Adviser in the completion of this dissertation.

Signed: 
Date: