Diplomarbeit

Food Craving and Nutritional Behavior in Bipolar Disorder
Ernährung und Food Craving bei Patienten mit bipolar affektiver Störung

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ZUSAMMENFASSUNG

Hintergrund. Studien weisen darauf hin, dass Verhaltensweisen wie Bewegungs- und Ernährungsgewohnheiten ursächlich am gehäuften Auftreten von Übergewicht und Adipositas bei Menschen mit bipolar affektiver Erkrankung (BP) beteiligt sind. So sollen sich etwa Personen mit BP weniger ausgewogen und ungesünder ernähren als der Durchschnitt der Bevölkerung; d.h. sie nehmen wenig Obst und Gemüse und viele fett- und zuckerreiche Lebensmittel zu sich.

Ziel. Das Ziel der vorliegenden Diplomarbeit war es, Ernährungsgewohnheiten sowie das Phänomen *food craving* (das starke Verlangen nach bestimmten Lebensmitteln) bei Personen mit BP näher zu untersuchen und mit jenen von gesunden Kontrollpersonen zu vergleichen.

Methoden. In diese Untersuchung wurden 50 PatientInnen einer Spezialambulanz für bipolar affektive Erkrankungen und 50 gesunde Kontrollpersonen eingeschlossen. Bei den StudienteilnehmerInnen wurden soziodemographische und anthropometrische Daten erhoben sowie eine Nüchtern-Blutabnahme durchgeführt. Zusätzlich dokumentierten alle TeilnehmerInnen ihr Ernährungsverhalten über vier Tage lang und füllten einen Fragebogen zum Thema food craving aus.

Ergebnisse. Personen mit BP unterschieden sich weder in der angegebenen Kalorienzufuhr noch in der Aufnahme von Makronährstoffen wesentlich von den gesunden Kontrollen, wiesen jedoch ein erheblich ungünstigeres metabolisches Risikoprofil auf. Des Weiteren zeigte sich bei PatientInnen im Vergleich zu Kontrollpersonen keine erhöhte Präferenz für ungesunde Lebensmittel. Das *food craving* insgesamt sowie das Verlangen nach fettreichen Lebensmitteln waren bei PatientInnen stärker ausgeprägt als bei Kontrollen. Darüber hinaus nahmen PatientInnen, jedoch nicht Kontrollen, die ein stärkeres Verlangen nach Süßem aufwiesen, mehr Süßigkeiten und mehr Saccharose zu sich.

Zusammenfassung. Durch den hohen Anteil an Personen, deren Ernährungsprotokolle durch ungenügende Validität auffielen (sogenannte *energy-underreporter*), sind alle Ergebnisse, die sich auf die Nahrungsaufnahme beziehen, mit Vorsicht zu interpretieren. Die vorliegende Arbeit gibt Hinweise auf die klinische Relevanz des Phänomens *food craving* bei Personen mit BD. Weitergehende Untersuchungen sollten sich mit der Prävalenz bei Männern und dem Verlangen nach fettreichen Lebensmitteln im Speziellen befassen.

ABSTRACT

Introduction. It is suggested that behavioral factors like physical activity and eating habits play a crucial role in the onset and maintenance of overweight and obesity in bipolar disorder. Previous research indicates that individuals with bipolar disorder tend to make less healthy food choices, e.g. consuming more foods high in fat and sugar and less fruit and vegetables, than the general population.

Objective. The objective of this diploma thesis was to further explore eating behavior in individuals with bipolar disorder by assessing differences in food craving, the preference for certain types of food, overall energy intake and macronutrient intake between a clinical collective and community control subjects.

Methods. Fifty individuals with DSM-IV bipolar disorder attending a specialist bipolar outpatient clinic and fifty reference subjects were recruited for this study. In addition to taking blood samples and the collection of sociodemographic and anthropometric data, participants completed the *Food Craving Inventory* as well as a *4-day estimated diet record*.

Results. Despite the fact that patients exhibited more metabolic risk factors (e.g. higher BMI, higher levels of triglycerides, and lower levels of HDL) than controls, the two groups did not differ substantially in overall reported energy and macronutrient intake. Additionally, patients were not prone to making less healthy food choices than controls. Individuals with bipolar disorder did experience higher levels of total food craving and fat craving than reference subjects. Furthermore, levels of craving for sweets were higher in male patients than in male controls. Among patients, but not among controls, the craving for sweets was related to reported intake of sweets and sucrose. Overall, cravers were more likely to be male, smokers, and have a higher waist-hip-ratio than non-cravers.

Conclusion. Due to the high percentage of energy-underreporters in this sample, all results regarding nutritional intake have to be interpreted with caution. However, the phenomenon of food craving appears to be of clinical relevance in individuals with bipolar disorder. The prevalence in men and the craving for high-fat foods in particular warrant further investigations.

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LIST OF ABBREVIATIONS

BLS	Bundeslebensmittelschlüssel
BDI	Beck Depression Inventory
BMI	Body mass index
BMR	Basal metabolic rate
DGBS	Deutsche Gesellschaft für Bipolare Störungen
DGPPN	Deutsche Gesellschaft für Psychiatrie und Psychotherapie, Psychosomatik und Nervenheilkunde
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders (4^{th} edition)
HAMD	Hamilton Rating Scale for Depression
HDL	High density lipoprotein
EEG	Electroencephalography
EFR	4-day estimated food record
GAF	Global Assessment of Functioning Scale
FCI	Food-Craving Inventory
LDL	Low density lipoprotein
MRI	Magnetic resonance imaging
OECD	Organization for Economic Co-operation and Development
ÖNWT	Österreichische Nährwerttabelle
PAL	Physical activity level
SCID-I	Structured Clinical Interview for DSM-IV Axis I Disorders
SES	Socioeconomic status
SGA	Second generation antipsychotic
SSRI	Selective serotonin re-uptake inhibitor
WHO	World Health Organization
YMRS	Young Mania Rating Scale

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1 INTRODUCTION

Bipolar disorder is a psychiatric illness that is associated with a particularly high burden of disease. It not only impacts mental and physical health, but has also psychosocial, occupational, and financial consequences for affected individuals. Of particular note is the dramatically shortened life expectancy associated with this illness. The life of an individual with (untreated) bipolar disorder may be cut short by up to nine years (Kasper et al., 2013).

Although diagnosis tools and treatment options are progressing constantly, the underlying pathomechanisms of the disease and its association with a multitude of comorbid conditions has yet to be fully understood. Individuals with bipolar disorder tend to exhibit an unfavorable metabolic and cardiovascular risk profile resulting in increased medical morbidity and mortality (Taylor & MacQueen, 2006). While biological, psychological and pharmacological determinants have been in the focus of previous research, it is suggested that behavioral factors like eating habits and levels of physical activity have to be taken into consideration (Wildes et al., 2006). Beyond the obvious associations between nutrition, body weight, and physical health, previous research also indicates that a relationship between diet and mood (and mood disorders) exists (Davison & Kaplan, 2012; Jacka et al., 2011).

1.1 Bipolar disorder

1.1.1 Definition, epidemiology and characteristics of bipolar disorder

Bipolar disorder is a chronic affective disorder characterized by alternating episodes of depression and episodes of elevated mood (mania or hypomania). Individuals with bipolar disorder exhibit periods of recovery with return to normal function (euthymia) between these episodes, however, residual or sub-syndromal symptoms can occur (Fagiolini et al., 2013).

Lifetime prevalence rates for bipolar disorder are 1.5-2%; they amount up to 6% if bipolar spectrum disorders are included (Möller, Laux & Kapfhammer, 2011). The mean age of onset of bipolar disorder is between 18-25 years. Bipolar disorder is equally prevalent in women and men (Möller et al., 2011).

The underlying mechanisms that cause bipolar disorder are not yet fully understood. Genetic factors seem to increase an individual's susceptibility for developing bipolar disorder. In addition, environmental factors and personality traits play important roles in its etiopathogenesis (DGBS & DGPPN, 2012).

Two main subtypes of bipolar disorder exist. The defining feature of bipolar I disorder is mania. To qualify as a manic episode according to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) individuals must exhibit persistently elevated, expansive, or irritable mood over the course of one week, or for less if they have to be hospitalized (Sadock et al., 2007). Symptoms also include hyperactivity, pressured speech or logorrhea, flight of ideas, and a decreased need for sleep. During mania, individuals exhibit erratic or hazardous behaviors, such as hypersexuality or excessive money spending as well as grandiose ideas, and even psychotic symptoms in the form of delusion of grandeur (Möller et al., 2011). Although social functioning is severely impaired, patients often lack acceptance of their condition and have to be committed to psychiatric care involuntarily (Möller et al., 2011).

Bipolar II disorder is indicated by hypomanic episodes persisting for at least four consecutive days according to the DSM-IV (Sadock et al., 2007). In hypomania, symptoms are commonly less severe and episodes are of shorter duration (Rothenhäusler & Täschner, 2012). There is no impairment in social or occupational functioning and psychotic features are not present (Sadock et al., 2007).

Another manifestation of bipolar disorder, cyclothymia, is characterized by a chronic course of periods of mild depression, which do not meet criteria for major depression, alternating with periods of slightly elevated mood (Möller et al., 2011).

Diagnostic features of bipolar depression are often similar to those of unipolar depressive episodes and consist of depressed mood, loss of interest, feelings of worthlessness or excessive guilt, and a reduced ability to concentrate (Sadock et al., 2007). However, individuals with bipolar II disorder in particular, are more likely to exhibit atypical depressive symptoms like hyperphagia, hypersomnia, oversensitivity to interpersonal rejection, and physical fatigue (Angst et al., 2006). Furthermore bipolar depression is associated with psychotic symptoms (Rothenhäusler & Täschner, 2012).

A mixed episode is characterized by the simultaneous presence of manic and depressive symptoms. Mixed episodes are associated with irritable mood, anxiety, excessive feelings of guilt, and aggression (Rothenhäusler & Täschner, 2012).

1.1.2 Course of illness and prognosis

In the majority of cases depressive symptoms are the primary manifestation of bipolar disorder. The median duration of an affective episode is four to five months (Möller et al., 2011). Bipolar disorder is associated with high rates of recurrence, though clinical courses vary between individuals (DGBS & DGPPN, 2012).

Patients with bipolar disorder are often incorrectly diagnosed with unipolar depression, anxiety disorder, schizophrenia or personality disorders (Young, 2009). The average time between the onset of bipolar disorder and its diagnosis is six years; which often leads to delayed or inadequate therapy and subsequently worsens the outcome (Möller et al., 2011). Other factors associated with severe clinical courses include young age at the onset of illness, female sex, mixed episodes, psychotic features, and rapid cycling, i.e. the quick succession of depressive and manic states (DGBS & DGPPN, 2012).

1.1.3 Comorbidities

The occurrence of comorbid conditions in bipolar disorder is common. Frequent psychiatric comorbidities of bipolar disorder include anxiety disorders, eating disorders, and personality disorders (Fagiolini et al., 2013). Substance abuse is also highly prevalent among individuals with bipolar disorder (Fagiolini et al., 2013). This not only pertains to illicit drugs but also to "social drugs" like tobacco and coffee (Maremmani et al., 2011).

The mortality rate in individuals with bipolar disorder is nearly three times higher than in the general population (Ösby, Brandt, Correia, Ekbom & Sparén, 2001). This can partly be attributed to the 21-fold suicide risk in those patients; between 20-50% of patients attempt suicide at least once over the course of their life (Möller et al., 2011) and 15-20% commit suicide (DGBS & DGPPN, 2012).

Aside from suicide, accidents and comorbid medical diseases are accountable for excess deaths in bipolar disorder (Möller et al., 2011). Cardiovascular risk factors such as obesity, hypertension, impaired glucose tolerance, and dyslipidemia are frequently present in individuals with bipolar disorder (Möller et al., 2011). Those risk factors are components of the metabolic syndrome which has high prevalence rates among individuals with bipolar disorder and affects up to 40% of patients with a serious mental illness (Bly et al., 2014).

Medical conditions like cardiovascular diseases, diabetes mellitus, diseases of the musculoskeletal system, and migraine are also common (DGBS & DGPPN, 2012) and are

associated with poorer psychiatric outcome and prognosis (Thompson, Kupfer, Fagiolini, Scott & Frank, 2006).

1.1.4 Therapy

In the psychopharmacological therapy of bipolar disorder a two-tiered approach is applied. Acute treatment during an affective episode focuses on ameliorating manic or depressive symptoms, while long-term treatment aims at preventing affective recurrence.

Mood stabilizers (lithium, valproate, carbamazepine, lamotrigine) and second generation antipsychotics (aripiprazole, clozapine, olanzapine, quetiapine, risperidone, and ziprasidone) are used in treatment of acute manic episodes (Kasper et al., 2013). Initial treatment usually consists of a single agent. However, if symptoms are persistent or severe the combination of mood stabilizers and second generation antipsychotics is indicated (Kasper et al., 2013).

Acute depressive episodes, analogous to unipolar depression, are treated with antidepressants, namely selective serotonin re-uptake inhibitors (SSRIs) and bupropione. Because of the risk of "switching" of mood into mania inherent in bipolar disorder, antidepressants should always be given in combination with an anti-manic mood stabilizing agent (Möller et al., 2011).

In long-term treatment, the same medication (with adjusted dosage) proven effective during acute episodes is continued for at least one year. However, life-long treatment is usually necessary in order to prevent relapses and recurrences (Kasper et al., 2013).

Aside from pharmacotherapy, psychoeducation, psychotherapy, electroconvulsive therapy, sleep restriction therapy, and light therapy are also utilized in the management of bipolar disorder (DGBS & DGPPN, 2012).

1.2 Overweight and obesity

1.2.1 Definition and etiology

The World Health Organization (WHO) defines overweight and obesity as "abnormal or excessive fat accumulation that may impair health" (WHO, 2014). To quantify overweight and obesity in adults the body mass index (BMI) is calculated by dividing weight in kilograms by height in meters squared. Overweight is defined by a BMI greater than or equal to 25

kg/m^2, obesity by a BMI greater than or equal to 30 kg/m^2 (WHO, 2014). In general, BMI does not differentiate between fat mass and lean mass, so it may not be an accurate measure in very muscular individuals. However, in most persons it correlates closely with body fat (Stein & Colditz, 2004).

The underlying cause for overweight and obesity is an energy imbalance; if energy intake exceeds energy expenditure an individual gains weight. Genetic, metabolic, behavioral, and environmental factors influence this process (Stein & Colditz, 2004). The worldwide growing rates of obesity may indicate that behavioral and environmental factors such as the ubiquitous availability of energy dense foods or increasingly sedentary lifestyles (Organization for Economic Co-operation and Development [OECD], 2012) lie at the root of this problem.

1.2.2 Epidemiology and health implications

Obesity rates are steadily rising worldwide. Based on most recent data, the OECD (2014) reports obesity rates of 18.4 % across its member countries and 12.4 % of obese adults in Austria. Overweight and obesity combined were prevalent in 52% of European adults (OECD, 2012) in 2012 and it is suggested that this number has increased since then.

A number of conditions are associated with an increased BMI. Type 2 diabetes, dyslipidemia and hypertension are frequent comorbid conditions and account for the increased cardiovascular risk in obese individuals (OECD, 2012). Those with abdominal obesity and a central fat distribution, where the excessive fat is stored around the stomach, are at an especially high risk of experiencing these conditions (Greten, Rinninger & Greten, 2010). Abdominal obesity is generally more common in men than in women who tend to store excess fat around the hips and thighs and can be measured by an increased waist circumference or an increased waist-hip ratio (Taylor & MacQueen, 2006).
Furthermore obesity is associated with a higher risk for cerebrovascular disease, gallbladder disease, arthritis, and certain types of cancer (Stein & Colditz, 2004).

In addition to medical morbidity, obese individuals may also exhibit impaired psychosocial functioning (Bray, 2004). Low self-esteem, poor mental health, and discrimination in different areas of life (education, employment or health care), as well as overall reduced quality of life are all common by-products of obesity (Fagiolini, Kupfer, Houck, Novick & Frank, 2003; Stein & Colditz, 2004).

1.2.3 Obesity in bipolar disorder

Previous research has established an association between overweight or obesity and mood disorders in general and bipolar disorder in particular. In a recent study, Reininghaus et al. (2014) found 69 % of bipolar patients to be overweight or obese. Previous studies (Fagiolini et al., 2002; Goldstein et al., 2011; McElroy et al., 2002, Yim et al., 2012) yielded similar results. Bipolar patients have a higher risk of obesity than the general population, with obesity rates ranging from 19% to 39% (Calkin et al., 2009; McIntyre, Konarski, Wilkins, Soczynska & Kennedy, 2006). One study reported on a 49% rate of abdominal obesity among bipolar adults (Fagiolini, Frank, Scott, Turkin & Kupfer, 2005). Those individuals are at an especially high risk of developing metabolic syndrome. In addition to central fat distribution the metabolic syndrome is characterized by dyslipidemia (low levels of high density lipoprotein and high levels of triglycerides), hypertension, and impaired glucose tolerance (Greten et al., 2010) It is associated with an increased risk for developing diabetes, cardiovascular disease, and cerebrovascular disease (Elmslie, Silverstone, Mann, Williams & Romans, 2000).

Apart from the higher risk of medical comorbidities, the co-occurrence of bipolar disorder and obesity is associated with a more severe course of illness and a worsened psychiatric prognosis, including more lifetime depressive and manic episodes, more severe and persistent index affective episodes and a greater likelihood of a depressive recurrence (Fagiolini, et al., 2003). In addition, an association between BMI and comorbid anxiety disorders as well as a history of suicide attempts was found (Fagiolini et al., 2004).

Although a range of potential contributing factors has been identified, the underlying mechanisms of obesity in bipolar disorder are likely to be complex and may vary from patient to patient (Wildes, Marcus & Fagiolini, 2006).

The weight-gaining effect of medication used in the treatment of bipolar disorder (e.g. mood stabilizers or second generation antipsychotics) has been subject to extensive research (reviewed by Keck & McElroy, 2003). It may, however, not account entirely for the phenomenon of obesity and weight gain in all bipolar patients, as this was observed before the employment of the psychotropic medication commonly used today (Kretschmer, cited in Calkin et al., 2009) and is also evident in drug-naïve patients (Maina, Salvi, Vitalucci, D'Ambrosio & Bogetto, 2008). Other facilitating factors that are presumed to play a role in this process are a genetic predisposition, disturbances of the neuro-endocrine system and

comorbid eating disorders (Wildes et al., 2006). In patients with bipolar disorder the loss of control over eating that is inherent to eating disorders like bulimia nervosa and binge eating, is associated with female sex, obesity, atypical depressive symptoms, and substance dependencies (Kawa et al., 2005; Wildes, Marcus & Fagiolini, 2008).

The nature of bipolar depression may also predispose patients for weight gain and obesity (Wildes et al., 2006); symptoms like hyperphagia on the one hand, and hypersomnia and fatigue on the other hand put bipolar individuals at an especially high risk.

In the general population, low socioeconomic status (SES) is associated with an increased risk for overweight and obesity (McLaren, 2007). Accordingly, the same inverse relation between SES and obesity has been demonstrated in patients with bipolar disorder (Fagiolini et al., 2002).

Ultimately, almost all of these factors impact or interact with behavioral processes related to food intake and physical activity and it is behaviors like overeating and lack of exercise that lead to weight gain and obesity in bipolar disorder (Wildes et al., 2006).

1.3 Diet and nutritional behavior

1.3.1 Determinants of nutritional behavior

What an individual eats, as well as how much, how often and why, is influenced by a multitude of parameters. Apart from the apparent physiological need for energy and nutrients to survive, various factors have an impact on nutritional behavior (Gedrich, 2003). One does not solely eat to relieve hunger; enjoyment of specific tastes and textures, health concerns, preferences for some foods, and aversions for others are shaping a person's nutritional choices equally to monetary considerations and expressing membership of a certain group. Situational circumstances like the availability of food dependent on season or economy, time restrictions and infrastructure also come into play (Gedrich, 2003).

1.3.3 Nutritional behavior in bipolar disorder

Several features inherent to bipolar disorder in particular may affect diet and eating behavior. Medication used for the treatment of bipolar disorder, like lithium, valproate and some second generation antipsychotics, are associated with craving for carbohydrates (Vick, Schwartz, Jindal, Nihalani & Jones, 2004), stimulation of appetite, and increased thirst

(Wildes et al., 2006). Evidently, this can result in higher consumption of certain foods. However, it may also prompt an individual to monitor their food intake especially closely or even restrict it in order to prevent potential weight gain. Dry mouth and excessive thirst can lead to an increased consumption of beverages other than water and subsequently higher energy intake (Elmslie, Mann, Silverstone, Williams & Romans, 2001).

Aside from being a possible adverse effect of psychotropic medication, hyperphagia is also a characterizing feature of atypical depression itself, which is associated with bipolar disorder (Angst et al., 2006). Some research suggests that (over)eating highly palatable food is used by individuals to avert negative mood states (Wildes et al., 2006). In contrast, severely depressed patients may eat less than usual or not eat at all. This may be caused by a loss of appetite typically seen in major depression (Möller et al., 2011) or lack of motivation to obtain or prepare food.

Another factor that may drastically impact eating behavior in bipolar disorder is the co-occurrence of an eating disorder that could result in uncontrollable eating, purging, and extreme dietary restriction (Wildes, Marcus & Fagiolini, 2007).

There are a few studies that have reported on diet, diet quality, and eating behavior of individuals with bipolar disorder. Notably, Elmslie et al. (2001) demonstrated that patients with bipolar disorder have a higher energy intake from carbohydrates and a higher total sucrose intake compared to the reference group. Additionally, in female patients, total daily energy intake was higher than in female reference subjects. Overall, patients consumed more cake, sweets and nonalcoholic beverages than control subjects, with the sucrose in these beverages accounting for most of the excess energy intake.

In a study that investigated eating behavior in a sample of individuals diagnosed with either bipolar disorder or schizophrenia, patients in both groups were more likely to exhibit poor eating habits than individuals without a diagnosis of severe mental disorder (Kilbourne et al., 2007). Patients with bipolar disorder in particular, reported having less than three servings of fruit or vegetables and eating only one meal per day, eating in solitude, and experiencing difficulties cooking for themselves. This, in combination with poor exercise habits, puts them at an especially high risk of gaining weight.

In their investigation, Davison and Kaplan (2012) arrived at similar conclusions. A sample of 97 adults with mood disorders (bipolar disorder and major depression) had a significantly higher intake of processed meats and foods high in sugar, fat, and salt than a

sample from the general population and an overall low intake of grains, fruits, vegetables, and meat.

In contrast, in a recent study by Bly et al. (2014) individuals with bipolar disorder as well as individuals with schizophrenia reported consuming fewer calories, fewer carbohydrates, fewer saturated fatty acids, and more dietary fiber when compared to the general population. However, for their apparent healthier dietary habits both groups compared unfavorably to reference subjects in most metabolic measures (BMI, waist-hip-ratio, blood glucose). According to the study's authors this may be an indication of factors other than poor diet being responsible for the increased rates of metabolic syndrome in individuals with severe mental illness. Particularly striking in this investigation was the fact that despite healthier lifestyle choices (including diet and use of second generation antipsychotics) bipolar patients rather than individuals with schizophrenia were at an especially high risk for metabolic syndrome.

Finally, there is a growing notion that the association between affective disorders and eating patterns is bi-directional (Jacka et al., 2011). If an individual's mood impacts his or her food choices, it may be equally possible that what an individual eats influences his or her mood. Prospective cohort studies found some evidence that adherence to a Mediterranean diet high in fruit and vegetables, grains, nuts, fish, olive oil, and with moderate consumption of red wine may provide protection against (unipolar) depression (Sánchez-Villegas et al., 2009). Additionally, a processed food dietary pattern (consisting of sweetened desserts, fried food, processed meat, refined grains, and high-fat dairy products) was associated with a higher risk of subsequent depression among a middle-aged cohort (Akbaraly et al., 2009). In the same sample a diet rich in fruit, vegetables, and fish resulted in lower odds of depression.

1.3.4 Dietary assessment and energy underreporting

The accurate assessment of diet and nutrition is of great importance for different reasons. On an individual level, the evaluation of a person's nutritional habits may lay at the foundation of diagnosis and therapy (Wallner, 2009). At population level, it allows for the characterization of relationships between nutrition and health and, subsequently, for the implementation of new policies (Prentice et al., 2011).

Retrospective methods of dietary assessment include 24-hour-dietary recalls and the taking of diet histories. Both methods rely heavily on the patients' memory as well as on the

ability and experience of the interviewer (Wallner, 2009). A prospective method like the weighed food record, where all food consumed within a period of time is weighed and recorded, may appear to depict food consumption precisely, however it is associated with high costs and demands high levels of patient cooperation (Wallner, 2009). In contrast, the estimated food record (EFR) requires participants to estimate consumed quantities of food. While due to these approximations it may be assumed that the EFR is less accurate than the weighed food record, previous research has demonstrated that the EFR depicts energy and nutrient intakes largely within 10 % of the values from the weighed food record (Chinnock, 2006).

Livingstone and Black (2003) define a valid diet record as "complete and accurate record of all food consumed on specific days, and where the choice of food and drink consumed has not been influenced by the act of recording". This indicates that dietary records do not always accurately reflect food consumption for a multitude of reasons.

Energy-misreporting, mostly in the form of underreporting energy intake, is a major limitation that pertains to all research relying on self-reported food intake. It is assumed that the underestimation of energy intake is also paralleled by the underestimation of nutrients (e.g. macronutrients, minerals) (Livingstone & Black, 2003). This introduces a bias into dietary assessment that may lead to the misinterpretation of relationships between diet and other health-related variables (Black, 2000). Research suggests that energy-underreporting is associated with female sex, older age, higher BMI, eating restraint as well as eating disinhibition, social desirability, and depression (reviewed by Maurer et al., 2006). In a sample of 97 individuals with mood disorders energy-underreporting was associated with weight gain due to side effects of antipsychotic medication and the intake of mood stabilizers (Davison, 2013).

By comparing self-reported energy intake with total energy expenditure, the validity of self-report dietary assessments can be evaluated (Maurer et al., 2006). Total energy expenditure can either be estimated or measured through various methods like doubly labeled water or indirect calorimetry. Since these methods are costly and often not feasible in larger investigations, the Goldberg cut-off is often used to screen for implausible diet records (Livingstone & Black, 2003). In an individual at stable weight energy intake equals energy expenditure (Black, 2000). Energy expenditure (and therefore energy intake) can be expressed as multiples of the basal metabolic rate (BMR) which depends on factor like age, sex, and

body composition (Livingstone & Black, 2003). The ratio of energy expenditure to BMR denotes the physical activity level (PAL). By comparing the PAL in a study population with the expected PAL energy intake energy intakes that do not meet requirements can be identified (Black, 2000).

1.4 Food Craving

A generally accepted belief about food cravings is that they are manifestations of a nutritional imbalance within the body that needs to be corrected. An iron deficiency may cause a craving for red meat; a craving for dairy products might indicate that the body lacks calcium. Although this possible association has also been subject of research, no scientific proof for these "homeostatic explanations" was found (Lafay et al., 2001).

1.4.1 Origin and definition

The term craving denotes an "intense, urgent desire" or "abnormal longing" (Merriam-Webster Inc., 2004) and is originally a construct of addictions literature (Franken, 2003). It is seen in heavy users of illicit drugs and alcohol who due to a "pleasurable, positively reinforcing effect" (Sinha, 2013) of those substances, experience a strong desire for them in their absence. Although it is presumed to play a critical role in the maintenance of addiction, the concept of craving is not undisputed and many competing theories exist (Franken, 2003).

Analogously, despite the fact that the experience of food craving may be a familiar one for a majority of people, no unifying theory for the concept of food craving exists. Although, Weingarten's and Elston's (1991) definition of food craving as an "intense desire to eat a certain food or type of food" is the one predominantly used, there are no universally accepted criteria to classify an individual as being a food craver (Lafay et al., 2001). Accordingly, suggested prevalence rates for food craving range from six percent in men (Lafay et al, 2001) to 97% in women (Weingarten & Elston, 1991).

1.4.2 Previous research on food craving

Especially the craving for carbohydrates has been in the focus of previous research. This is, firstly, due to its association with obesity, eating disorders, atypical depression, seasonal affective disorder, and the premenstrual syndrome (Christensen & Pettijohn, 2001;

Lafay et al., 2001; Wurtmann & Wurtmann, 1995). Secondly, it has been demonstrated that carbohydrate-rich foods like chocolate, other sweets and sweet desserts seem to be the most craved foods in the majority of individuals (Christensen & Pettijohn, 2001; Hill, 2007; Lafay et al., 2001). It is notable that the foods, that self-proclaimed carbohydrate cravers report to be craving, are not made up from carbohydrates in their entirety or even for the most part. These are predominantly sweet foods that are also high in fat (Christensen & Pettijohn, 2001).

Across different studies food craving seems to be more prevalent in women than in men (Hill, 2007; Lafay et al., 2001; Zellner, Garriga-Trillo, Rohm, Centeno & Parker, 1999). Women seem to exhibit even more food craving in their premenstrual phase, along with increased consumption of carbohydrate-rich snacks and higher overall energy intake (Dye, Warner & Bancroft, 1995).

Overall, food craving is not equivalent to increased consumption of food and accordingly, hunger or energy depletion are not prerequisites for craving (Hill, 2007). However, the relationship between food craving and dietary restraint has attracted rather much attention. Although some research failed to prove a connection (Hill, Weaver & Blundell, 1991), there is evidence, that dieters experience more food cravings (Hill, 2007) and, conversely, cravers are more likely to restrain their eating and exhibit concerns regarding their weight (Lafay et al., 2001). Additionally, dieting individuals also experience more difficulties resisting their cravings compared to non-dieters (Massey & Hill, 2012).

In one study, individuals reporting more food cravings while dieting also exhibited more episodes of emotional eating and binge eating and less confidence in their ability to stick to a diet or lose weight (Delahanty, Meigs, Hayden, Williamson & Nathan, 2002). In the same sample of glucose-impaired, overweight adults food craving was independently correlated to BMI.

Noteworthy, in this context, are findings that link fasting and diets extremely low in energy to a general decrease in food craving (Hill, 2007).

Although food cravings seem to be a common occurrence in young adults, evidence suggests that the number of craving episodes decreases as individuals age (Pelchat, 1997).

Across all research, the strongest relation observed seems to be the one between food craving and mood. Christensen and Pettijohn (2001) demonstrated that in the majority of individuals who identified as carbohydrate cravers (72% of participants in their study), anxiety, fatigue, and depression preceded craving episodes. On contrast, protein cravers were more likely to report feeling hungry, happy or bored at the onset of craving. Lafay et al.

(2001) investigated a sample of more than thousand healthy adults and arrived at similar conclusions. In women, food cravings were associated with negative affective states, namely boredom, solitude, annoyance or depression – especially if they gave in to their cravings. In men, feelings of happiness and relaxation were most prevalent. In their study of 129 women, Massey and Hill (2012) categorized individuals into three groups according to their dieting behavior: dieters, non-dieters, and an intermediate group of "watchers" – women, who watched what they were eating in order to avoid gaining weight. Episodes of food craving were similarly associated with anxiety, tension, irritability, emotional vulnerability, and hunger across all three groups.

1.4.3 Proposed pathophysiological mechanisms

Most of the explanatory models of food craving are built upon its association with negative mood states. Most common is the hypothesis that in depressed or anxious individuals low levels of brain serotonin result in cravings for carbohydrates (Ventura, Santander, Torres, & Contreras, 2014). After the ingestion of a meal high in carbohydrates and low in protein, the secretion of insulin from the pancreas leads to an increased plasma ratio of tryptophan to other large neutral amino acids. Thus, the amount of tryptophan that passages across the blood-brain barrier rises. Tryptophan is a serotonin precursor and therefore, with more tryptophan available the synthesis of serotonin in the brain increases (Wurtmann & Wurtmann, 1995). Accordingly, the consumption of food rich in carbohydrates is regarded as a form of self-medication in times of depression or other negative mood states (Christensen & Pettijohn, 2001). Although this theory is a much-cited one, it is not without controversy. As Ventura et al. (2014) pointed out, it suggests latency between carbohydrate ingestion and the amelioration of mood symptoms, when in reality, this effect is immediate.

Another attempt at an explanation suggests that some individuals with mood or anxiety disorders exhibit higher levels of hedonic response to sweet taste, that, in part, may be genetically determined. This hedonic response to highly palatable foods, like chocolate, is induced by the endogenous opioid system. Repeated consumption may cause repeated release of endogenous opioids, which subsequently, can lead to binge eating (Ventura et al., 2014).

Some research (reviewed by Ventura et al. 2014) draws comparisons between the craving for carbohydrates and substance-related addiction. Addictive substances are able to evoke positive mood states by raising levels of dopamine and opioids and also modify the brain's motivational system. It is proposed that the repeated consumption of highly palatable

foods acts in similar ways to counteract negative affective states or the prospect of withdrawal. Opponents of this theory maintain that the comparison between addictive substances and food is invalid, as food is essential for survival and withdrawal from it is not possible (Christensen & Pettijohn, 2001).

The craving for carbohydrate and subsequently its consumption may, according to some literature, also occur as a response to stress. While hunger and eating are suppressed in acutely stressful situations, cortisol mediates stimulation of appetite afterwards. This leads to hyperphagia and, when perpetuated by chronic stress, weight gain (Takeda et al., 2004).

It is proposed that in individuals with genetic susceptibility, craving and emotional eating of carbohydrates can be a way of coping with stressful situations that is the result of an upbringing that failed to convey adequate methods of managing emotions. While emotional eating in reaction to distress is prevalent in obese adults, it has been demonstrated that children react to distress with a loss of appetite which is considered the natural biological response (Ventura et al., 2014).

Although many attempts at explaining the underlying pathophysiological mechanisms of food craving have been made, a unifying, comprehensive theory has yet to be postulated.

1.5 Research questions and hypotheses

The objective of this study was to further explore eating behavior and related variables in individuals with bipolar disorder. The increased prevalence of obesity in this population is well documented (Fagiolini et al., 2002; Yim et al., 2012) and is associated with a heightened risk for medical conditions like cardiovascular disease, cerebrovascular disease, and diabetes mellitus (DGBS & DGPPN, 2012). Although it is presumed that there are multiple pathways leading to the development of overweight and obesity in bipolar disorder, nutritional behavior is likely to play a role in this process. Furthermore, the phenomenon of food craving (especially the craving for carbohydrates) seems to be prevalent in both dysphoric individuals (Christensen & Pettijohn, 2001; Lafay et al., 2001) and those taking psychotropic medication (Vick et al., 2004), which makes it particularly interesting when exploring eating behavior in individuals with bipolar disorder.

Therefore, the aim of this investigation is to examine eating behavior in individuals with bipolar disorder by assessing differences in food craving, overall energy intake,

preference for certain types of food, and macronutrient intake between a clinical collective and community control subjects.

Research question 1: Do diet and eating behavior of individuals with bipolar disorder differ from those of control subjects?

Previous investigations suggest that individuals with bipolar disorder differ in their eating behavior from those not affected by this condition. That may, in part, not only lead to a higher total energy intake, but also to less healthy food choices – namely, consuming more foods high in fat and sugar and less fruit and vegetables (Davison & Kaplan, 2012; Elmslie et al., 2001; Kilbourne et al., 2007).

Hypothesis 1a: Individuals with bipolar disorder consume a higher amount of macronutrients and more daily total energy than reference subjects.

Hypothesis 1b: Individuals with bipolar disorder consume more calories from sweets and baked goods, as well as a higher amount of sucrose than control subjects.

Hypothesis 1c: Individuals with bipolar disorder consume fewer calories from fruits and vegetables, as well as less dietary fiber than control subjects.

Research question 2: Do bipolar individuals experience more food craving than control subjects?

Due to the fact that previous research has linked negative mood states in general, (Christensen and Pettijohn, 2001), atypical depression in particular (Angst et al., 2006), and the intake of certain psychotropic medication (Vick et al., 2004) to the phenomenon of food craving, especially the craving for sweet, carbohydrate-rich foods, it stands to reason that individuals with bipolar disorder might experience more food craving than individuals without a psychiatric illness.

Hypothesis 2a: Individuals with bipolar disorder experience more food craving than control subjects, especially craving for carbohydrates and sweets.

Hypothesis 2b: Patients taking psychotropic medication associated with carbohydrate craving (lithium, second generation antipsychotics, and antiepileptic agents) experience more carbohydrate craving than individuals not taking this type of medication.

Research question 3: Is food craving related to food consumption?

There is research that indicates that food craving is associated with restrained eating rather than consumption (Lafay et al., 2001) and failed to prove a connection between high levels of food craving and high levels of food intake. However, if food craving does play a role in the onset and maintenance of obesity in bipolar disorder it can be hypothesized that patients may more frequently give in to their cravings.

Hypothesis 3: Individuals who exhibit higher levels of food craving also consume a higher number of calories.

Research question 4: Do food cravers differ from non-cravers in demographic and biological characteristics?

Earlier investigations have prompted the notion that food craving is associated with female sex, young age, and higher BMI (Delahanty et al., 2002; Lafay et al., 2002; Pelchat, 1997). Additionally, it has been proposed that stronger cravings for cigarettes among smokers may not only complicate attempts at smoking cessation but may also be associated with equally high levels of cravings for palatable food (Styn, Bovbjerg, Lipsky & Erblich, 2013).

Hypothesis 4: Cravers differ from non-cravers in distinct demographic and biological characteristics like sex, age or BMI.

2 Methods

The investigation presented in this diploma thesis is part of an ongoing study conducted at the Department of Psychiatry at the Medical University of Graz. The BIPFAT-Study aims to explore the relationship between bipolar disorder and obesity, metabolism, lifestyle, and cognitive function. Not all variables obtained in the BIPFAT-Study are of interest for this thesis. Below, only those essential for the investigation at hand are outlined in greater detail.

The BIPFAT study protocol was approved by the Ethics Committee of the Medical University Graz.

2.1 Participants

In this investigation 50 individuals with bipolar disorder and 50 healthy controls were included. Bipolar participants were recruited while being in-patients at the Department of Psychiatry or while attending a dedicated outpatient clinic for bipolar disorder. To confirm the psychiatric diagnosis the *Structured Clinical Interview* (SCID-I) was conducted by either a psychiatrist or a psychologist. All patients fulfilled the DSM-IV diagnostic criteria (American Psychiatric Association, 1994) for bipolar disorder. Participants had to be of legal age and euthymic at the time of study. To rule out a present depressive or manic episode the Hamilton Rating Scale for Depression (HAMD; Hamilton, 1960) and the Young Mania Rating Scale (YMRS; Young, Biggs, Ziegler & Meyer, 1978) were administered, respectively. A HAMD score below 15 and an YMRS score below 6 were considered consistent with euthymia (Reininghaus et al., 2014). Participants also completed the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock & Erbaugh, 1961) – a self-report tool for measuring depressive symptoms. Furthermore, psycho-social and occupational functioning of all patients was evaluated with the Global Assessment of Functioning Scale (GAF; Endicott, Spitzer, Fleiss & Cohen, 1976).

Other exclusion criteria were severe medical or neurological comorbidities like active cancer, chronic obstructive lung disease, systemic lupus erythematosus, Alzheimer's disease, Parkinson's disease, and multiple sclerosis.

All individuals in the reference group were members of the general public and were not recruited from a health care facility. Additional exclusion criteria for this group were a

lifetime psychiatric diagnosis and first or second degree relations to individuals with psychiatric disorders.

A written informed consent was obtained from all participants.

2.2 Measures

2.2.1 Biological and anthropometric parameters

A fasting blood sample was collected from all participants. Among others, the following parameters were analyzed: glucose, hemoglobin A1c, and lipids (triglycerides, total cholesterol, high density lipoprotein [HDL], and low density lipoprotein [LDL]).

Weight, height, hip circumference, and waist circumference were measured for each subject and BMI and waist-hip ratio were calculated.

2.2.3 Dietary assessment

2.2.3.1 Four-day estimated food record

In order to assess a nutritional profile all participants completed a *4-day EFR* to document their food intake on four consecutive days (see Appendix A). Participants were asked to protocol what they consumed at mealtimes (breakfast, lunch, and dinner) as accurately as possible. Any food and beverages consumed between breakfast and lunch or between lunch and dinner were considered midmorning snacks and afternoon snacks, respectively. Food intake after dinner was recorded as late night snack.

Food records consisted of everything participants ate and drank (including portion sizes), the time, and the location of the meal. If participants could not precisely quantify how much of a certain food they had eaten, they were asked to use terms like “a little”, “medium-sized” or “a lot”. For further reference a brief written instruction was included with the EFR.

The evaluation and nutritional analysis of the 4-day food records were performed with *nut.s-nutritional software version 1.32.03* (dato Denkwerkzeuge, 2010). All data regarding nutritional value and portion size in the *nut.s* software are based on the “*Bundeslebensmittelschlüssel*” (BLS; Max Rubner Institut, 2010) and its regional supplement for Austria, the “*Österreichische Nährwerttabelle*” (ÖNWT; dato Denkwerkzeuge, 2014).

The BLS was developed as a reference tool for the evaluation of nutritional surveys in German speaking countries. All items in the BLS are encrypted with a hierarchically structured 7-figure code. The first letter of this code classifies an item into the major food groups. Letters B through W refer to:

- Bread and rolls (B)
- Cereal products, grains, flours, milled products, rice (C)
- Cakes, tarts, pastries, biscuits (D)
- Eggs and egg products, noodles (E)
- Fruit and fruit products (juices, jams, marmalades; F)
- Vegetable and vegetable products (G)
- Legumes, pulses, nuts, oilseeds and other seeds (H)
- Potatoes and potato products, starchy roots and tubers, mushrooms (K)
- Milk, dairy products, cheese (M)
- Non-alcoholic beverages (coffee, tea, soft drinks; N)
- Alcoholic beverages (beer, wine, spirits; P)
- Oils, fats, butter, lard (Q)
- Spices, seasonings, raising agents, condiments (R)
- Sweets, sugar, candy, chocolate, spread (sweet), ice cream (S)
- Fish and fish products, shrimps, crayfish, shellfish, mollusks (T)
- Meat (beef, veal, pork, mutton; U)
- Venison, poultry, feathered game, offal (V)
- Sausage and other meat products (W)

Categories X and Y comprise composite dishes containing mainly vegetable or animal products respectively.

Positions two to four refer to further divisions of the twenty main groups and specify the individual item. Position five and six classify how the items have been processed as well as how and where they were prepared (household, restaurant kitchen or commercial kitchen). Position seven determines the reference weight for an item's nutritional specifications.

From the multitude of nutritional variables available from *nut.s* software some were chosen *a priori* for further analysis. Total energy intake, energy intake at each mealtime, and

daily intake of macronutrients were selected to compare eating behavior of individuals with bipolar disorder and control subjects. Additionally, intake of sucrose, and energy intake from sweets and sweet baked goods (that is food categorized in groups D and S, respectively) as well as energy intake from fruit and vegetable (that is, food categorized in groups F and G) were assessed.

In the evaluation of dietary intake a food item mentioned in the EFR was first entered into the *nut.s* software. From all options given either an exact match or the closest match available was selected. For composite dishes existing recipes (from groups X and Y of the BLS) were used. If no exact amount consumed was stated, the standard portion size predetermined by the BLS (or if applicable small or large portion) was chosen. All meals were entered according to the participants' specifications; that is, if a participant considered something to be lunch it was entered as lunch.

Although the majority of the nutritional data obtained represents the mean of dietary intake over four days, in a few cases individual days had to be omitted since participants didn't complete the EFR that day or interpretation of the EFR was not possible.

In this investigation BMR was calculated by using Schofield's equation (Wallner, 2009) and a cut-off PAL of 1.55 for underreporting was determined (Livingstone & Black, 2003).

2.2.3.4 Food-Craving Inventory

Participants completed a German version of the *Food-Craving Inventory* (FCI; White, Whisenhunt, Williamson, Greenway & Netemeyer, 2002), a self-report measure for general and specific cravings (see Appendix B). It allows individuals to indicate how often they experienced a craving for a certain type of food, that is, the intense desire to consume this particular food (Weingarten & Elston, 1990), over the past four weeks using a 5-point Likert scale (A = Never, B = Rarely, C = Sometimes, D = Often, E = Almost daily).

The FCI consists of 28 items that form four factors. These factors correspond to four subscales for specific cravings for foods high in fat, sweets, carbohydrates and starches, and fast food, respectively. The high fat factor contains eight items including fried chicken, sausages, cold cuts, pork roast, steak, fried fish, "Wiener Schnitzel", and bacon. The eight items composing the sweets factor are chocolate, candy, ice cream, cookies, chocolate wafers, sweet pastries, tortes, and cake. The carbohydrates/starches factor contains the eight items

rice, pasta, baked potatoes, toast, rolls, pancakes, sponge cake, and cereal. The fast food factor is composed of four items: hamburgers, potato chips, pizza, and French fries.

Values for each specific craving were obtained by adding up the single values belonging to each respective subscale. The total amount of craving is the sum of the four subscales, or alternatively the sum of all 28 items of the FCI.

2.3. Procedure

Bipolar individuals were invited to participate in the BIPFAT study while being in-patients at the Department of Psychiatry at the Medical University Graz or during their visits at the specialist bipolar outpatient clinic. Control subjects were recruited from the general public. If an individual decided to participate, an appointment was arranged.

All participants had been fasting for at least eight hours prior to their first visit, which was usually scheduled at 8:00 am. First, the risks and benefits associated with participating in the study were briefly outlined to them and written consent was obtained. To ensure that all participants were euthymic, HAMD (Hamilton, 1960) and YMRS (Young et al., 1978) were administered. Additionally, all participants completed the BDI (Beck et al., 1961) for self-evaluation of depressive symptoms. With patients, a detailed psychiatric history was taken and the SCID-I was administered by a psychiatrist or psychologist. Then a blood sample was collected and participants were served a small breakfast.

In a brief interview relevant socio-demographic data were collected. This included ethnicity, level of education, occupation, marital status, smoking and exercising habits, as well as medical history.

Anthropometric data were obtained by weighing each participant and measuring their height, waist circumference, and hip circumference. Finally, participants were given several questionnaires to complete at home. Besides gaining insight on diet and eating behavior, these provided information on eating disorders and smoking habits.

Participants were to return all questionnaires at their second visit where a MRI-scan of the brain was scheduled and, if requested, results were discussed.

2.4. Statistical analysis

All statistical analyses were performed with SPSS 22.0 (SPSS Inc.). The *a priori* statistical significance level was set to $\alpha = .05$. Due to the exploratory nature of this investigation no correction of the alpha-level for multiple comparisons was made. In addition, since the present diploma thesis has to be regarded as a pilot study for further studies no covariates were included in the analyses.

Since eating behavior is subject to sex- and gender specific influences all analyses regarding dietary intake (e.g. energy and macronutrient consumption) were performed separately for female and male participants.

Due to the non-Gaussian distribution of the nutritional data, the non parametric Mann-Whitney-U test was used for comparing means between two groups and median values were reported. The estimated effect size *r* was calculated by converting the z-score. A small effect size is denoted by $r > .10$, $r > .30$ is considered a medium effect size, and $r > .50$ represents a large effect (Field, 2013).

All correlation analyses were performed using Spearman's correlation for non parametric distributed data. Additionally, bias corrected and accelerated bootstrap 95 % confidence intervals were computed.

Of the 100 study participants seven did not complete the FCI, therefore the sample size for all calculations concerning food craving was 93. Due to the non-Gaussian distribution of the data, the non parametric Mann-Whitney test was used for comparing levels of food craving between the two groups.

For the comparison of craving and non-craving groups Pearson´s chi-square tests were used for categorical data and *Cramér's V* was quoted as effect size (Field, 2013). For all continuous variables comparisons were performed with independent *t*-tests. To asses effect sizes *Cohen's d* was calculated (Field, 2013). A small effect size is denoted by $d > 0.2$; $d > 0.5$ is considered a medium-sized effect, and $d > 0.8$ represents a large effect size.

3 Results

3.1 Cohort characteristics

A brief overview of the participants' demographic characteristics is presented in Table 1.

Table 1. Demographic Characteristics

Variable			*N*	*Mean*	*SD*
Total Sample			100		
	Female		58		
	Male		42		
	Age			45.96	14.97
	Patients		50		
		Female	25		
		Male	25		
		Age		46.45	13.19
	Controls		50		
		Female	33		
		Male	17		
		Age		45.47	16.64

For a detailed description of the cohort's anthropometric parameters see Table 2.

In the patient group 18 (36%) individuals were of normal weight (defined by a BMI between 18.50 and 24.99 kg/m^2). Among controls, 27 (54%) individuals were of normal weight and one (2%) individual was underweight (defined by a BMI lesser than 18.50 kg/m^2). In both groups 15 (30 %) individuals were overweight (defined by a BMI between 25.00 and 29.99 kg/m^2). However, among patients 17 (34 %) individuals were obese (defined by a BMI greater than or equal to 30 kg/m^2), compared to only 7 (14 %) in the control group.

There was a significant difference between mean BMI of patients (M = 28.47, SD = 6.56) and control subjects (M = 24.99, SD = 3.63, t (98) = 3.28, p = .001, d = 0.66). BMI did not differ significantly between female (M = 26.09, SD = 5.49) and male (M = 27.62, SD = 5.60) individuals.

Table 2. Anthropometric Parameters of the Sample

Variables	**Patients (*n* = 50)**	**Controls (*n* = 50)**	
	Mean (SD)	***Mean (SD)***	***p***
Weight [kg]	83.99 (21.92)	72.40 (12.77)	**.002**
Females	74.86 (16.55)	67.59 (11.41)	.067
Males	93.12 (23.10)	81.73 (10.40)	.063
Height [cm]	171.51 (10.00)	169.95 (9.00)	.396
Females	163.82 (5.26)	165.59 (5.57)	.234
Males	179.20 (6.58)	178.41 (9.93)	.701
BMI [kg/m^2]	28.47 (6.56)	24.99 (3.63)	**.002**
Females	28.01 (6.66)	24.63 (3.92)	**.030**
Males	28.93 (6.56)	25.69 (3.00)	.065
Waist circumference [cm]	95.41 (17.33)	86.69 (11.43)	**.004**
Females	90.46 (15.72)	84.15 (11.24)	.096
Males	100.36 (17.76)	91.62 (10.40)	.076
Hip circumference [cm]	102.77 (13.63)	97.51 (9.16)	**.026**
Females	103.22 (12.59)	98.02 (11.24)	.089
Males	102.32 (14.83)	96.53 (6.62)	.140
Waist-hip-ratio	0.93 (0.10)	0.89 (0.08)	**.036**
Females	0.87 (0.07)	0.86 (0.06)	.416
Males	0.98 (0.09)	0.95 (0.08)	.228

The prevalence of overweight and abdominal obesity (defined by a waist-hip-ratio greater than or equal to 0.9 and 0.8 for men and women, respectively) across the sample was 79 % (*n* = 79). In male individuals, 78.57 % had a waist-hip-ratio greater than or equal to 0.9, and 79.31 % of female participants had a waist-hip-ratio greater than or equal to 0.8.

In Table 3 biological parameters of patients and controls are presented. Patients had significantly lower levels of HDL as well as higher levels of triglycerides than controls.

Table 3. Biological Parameters of Patients and Controls

	Patients	**Controls**	
	M (SD)	***M (SD)***	***p***
Glucose [mg/dl]	98.05[a] (19.64)	94.35[b] (7.38)	.283
Hb A1c [mmol/mol]	36.33[c] (6.91)	35.17[b] (2.98)	.305
Cholesterol [mg/dl]	200.90[d] (49.25)	195.35[b] (32.87)	.521
LDL [mg/dl]	117.72[d] (40.93)	109.78[b] (32.83)	.305
HDL [mg/dl]	57.46[e] (16.53)	68.20[b] (17.66)	**.003**
Triglycerides [mg/dl]	125.33[d] (83.21)	87.04[b] (50.36)	**.008**

Note. [a]*n = 41,* [b]*n = 46,* [c]*n = 39,* [d]*n= 48,* [e]*n = 47. Abbreviations: Hemoglobin A1c (Hb A 1c), Low density lipoprotein (LDL), High density lipoprotein (HDL)*

A brief overview of clinical characteristics of patients partaking in this investigation is presented in Table 4. Overweight or obese patients did not differ in clinical parameters from patients of normal weight.

Table 4. Clinical Parameters of Patients

	Normal weight	**Overweight or obesity**	
	N (%)	***N (%)***	***p***
Female	11 (22.00)	14 (28.00)	.232
Male	6 (12.00) } 17 (34.00)	19 (38.00) } 33 (66.00)	
	M (SD)	***M (SD)***	
Illness duration [years]	17.19[a] (2.73)	20.67 (2.31)	.368
GAF	69.76 (17.24)	70.58[b] (14.13)	.860
HAMD	5.47 (3.13)	5.09 (4.54)	.731
YMRS	0.59 (1.12)	0.58 (1.44)	.975
BDI	8.31[a] (8.79)	12.45 (10.30)	.174

Note. [a]*n =16,* [b]*n = 31. Abbreviations: Global Assessment of Functioning Scale (GAF), Hamilton Rating Scale for Depression (HAMD), Young Mania Rating Scale (YMRS), Beck Depression Inventory (BDI).*

3.2 Dietary Intake

3.2.1 Macronutrients and energy intake

Hypothesis 1a stated that individuals with bipolar disorder would consume a higher amount of the macronutrients protein, fat, and carbohydrate as well as more total daily energy than reference subjects.

The comparison of energy and macronutrient intake between patient and control group was performed separately for females and males using the Mann-Whitney-U test.

Analyses in females

In females total daily energy intake did not differ significantly between patient and controls. Female patients did not differ significantly from female reference subjects in the amount of energy they consumed for breakfast, for lunch, or for dinner.

No significant differences between female patients and female controls in the consumption of energy for midmorning snacks, afternoon snacks, and late night snacks were observed. In Table 5 median energy intake in female participants is presented.

Table 5. Median Energy Intake in Females in kcal

	Total (*n* = 58)	**Patients (*n* = 25)**	**Controls (*n* = 33)**
	Mdn	***Mdn***	***Mdn***
Breakfast	287.22	322.90	282.53
Midmorning snack	63.64	77.20	46.34
Lunch	560.00	520.00	566.27
Afternoon snack	153.39	156.62	150.16
Dinner	449.89	381.91	468.55
Late night snack	56.73	66.00	32.27
Total daily energy	1754.30	1816.03	1709.93

Female patients did not consume significantly more carbohydrate per day than female controls. Furthermore, no significant difference between female patients and female controls was found in the amount of protein and fat consumed. For the median amount of consumption of carbohydrate, protein, and fat per day in females see Figure 1.

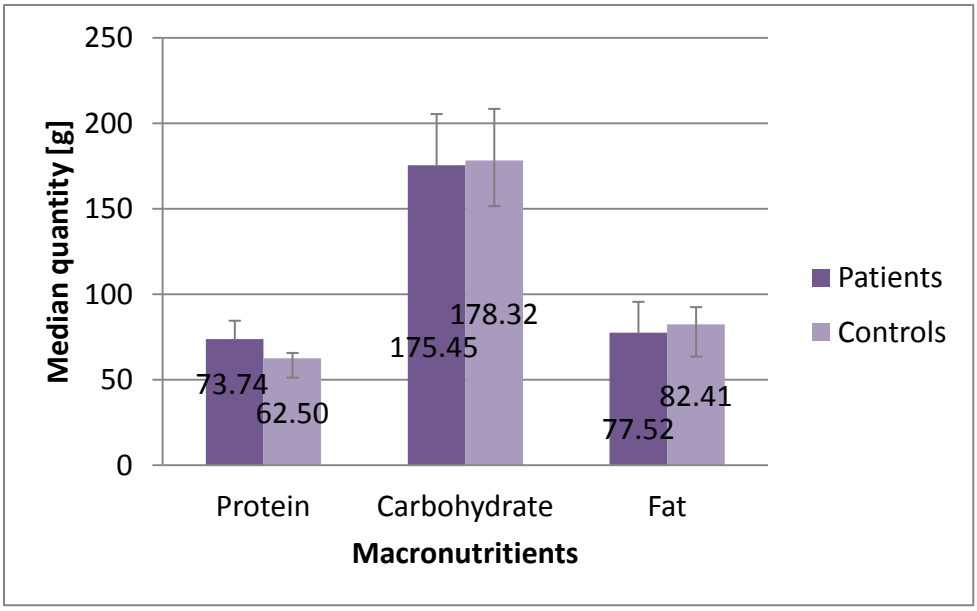

Figure 1. Median Daily Macronutrient Consumption in Female Patients (n = 25) and Controls (n = 33) [*Error bars: 95 % CIs*]

Analyses in males

Total daily energy intake in male patients did not differ significantly from male reference subjects. Additionally, the two groups did not differ in consumption of energy for lunch or for dinner. Males in the patient group did, however, consume more energy for breakfast, U = 114.00, z = - 2.52, p = .012, r = - .39.

No significant differences between male patients and male controls in consumption of energy for midmorning snacks, afternoon snacks, and late night snacks were observed.

In Table 6 median energy intake in male participants is presented.

Table 6. Median Energy Intake in Males in kcal

	Total (n = 42)	**Patients (n = 25)**	**Controls (n = 17)**
	Mdn	***Mdn***	***Mdn***
Breakfast	347.45	401.91	268.16
Midmorning snack	50.53	46.77	52.61
Lunch	683.89	714.75	649.23
Afternoon snack	109.55	93.57	176.72
Dinner	517.02	478.80	612.55
Late night snack	135.26	148.67	132.02
Total daily energy	1963.98	2089.46	1897.14

In males the amount of carbohydrates consumed daily did not significantly differ between patients and controls. However, male patients did consume significantly more protein than male reference subjects, U = 134.00, z = - 2.01, p = .044, r = -.31. The amount of fat consumed did not differ significantly between the two groups. The median amount of macronutrients consumed daily in males is presented in Figure 2.

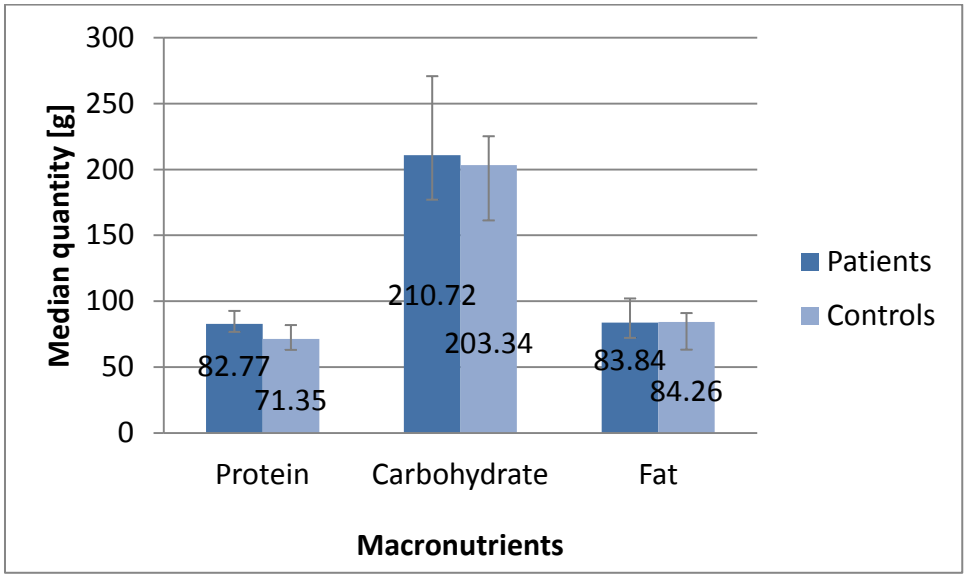

Figure 2. Median Daily Macronutrient Consumption in Male Patients (n = 25) and Controls (n = 17) [*Error bars: 95 % CIs*]

3.2.2 Intake of sweets, baked goods, and sucrose

Hypothesis 1b stated that individuals with bipolar disorder would consume more calories from sweets and baked goods as well as a higher amount of sucrose than reference subjects.

In Figure 3 and Figure 4, the median amount of sweets and baked goods consumed per day is presented for female and male participants, respectively. For median sucrose intake refer to Figure 5.

In female participants there was no significant difference in consumption of sweets between patients and controls. Additionally, the two groups did not significantly differ in consumption of baked goods or sucrose.

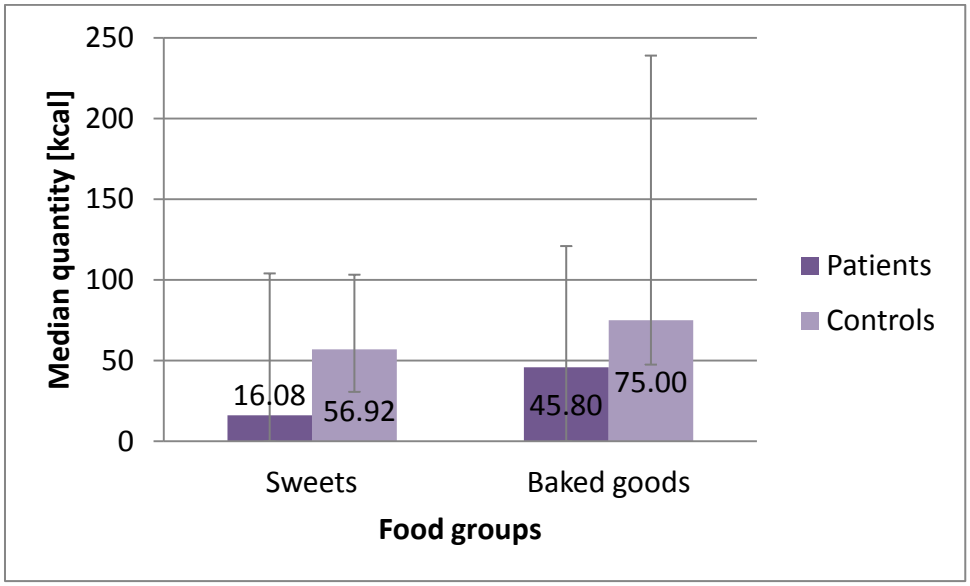

Figure 3. Median Daily Consumption of Sweets and Baked Goods in Female Patients (n = 25) and Controls (n = 33) [*Error bars: 95 % CIs*]

Consumption of sweets in male individuals with bipolar disorder did not significantly differ from male individuals in the control group. Furthermore, there were no significant differences in consumption of baked goods or sucrose intake.

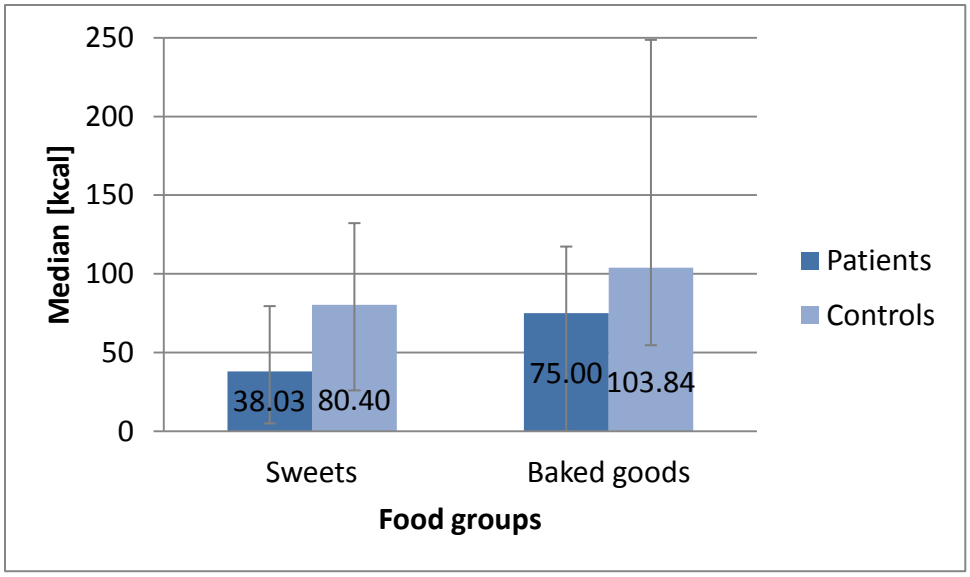

Figure 4. Median Daily Consumption of Sweets and Baked Goods in Male Patients (n = 25) and Controls (n = 17) [*Error bars: 95 % CIs*]

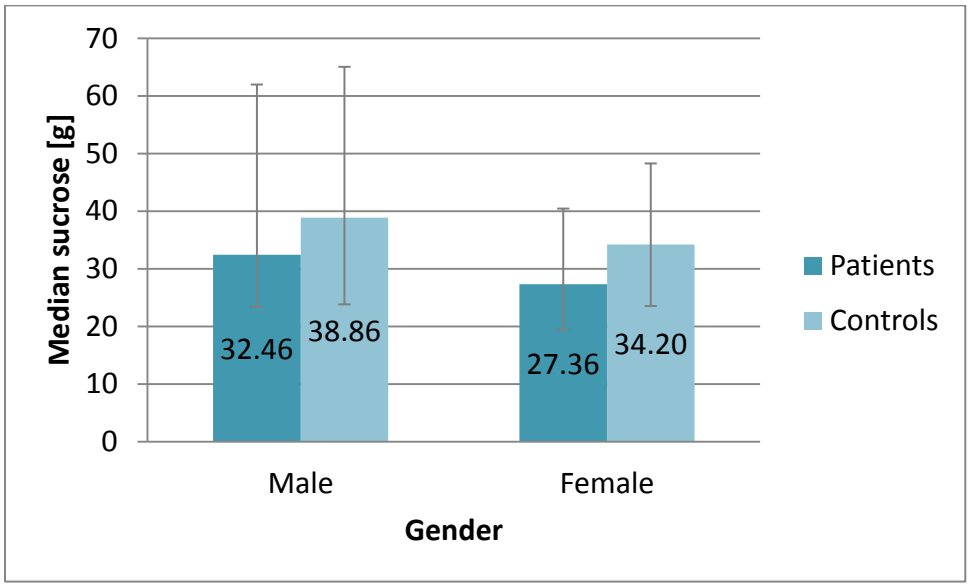

Figure 5. Median Daily Sucrose Intake in Patients (n = 50) and Controls (n = 50) [*Error bars: 95 %* CIs]

3.2.3 Fruit and vegetable intake

Hypothesis 1c stated that individuals with bipolar disorder would consume fewer calories from fruit and vegetables as well as less dietary fiber than reference subjects.

In Figure 6 and Figure 7, the median amount of daily fruit and vegetable consumption for female and male participants respectively is presented. Median intake of dietary fiber per day is presented in Figure 8.

In female participants there was no significant difference in consumption of fruit between patients and controls. Additionally, the two groups did not significantly differ in consumption of vegetables or intake of dietary fiber.

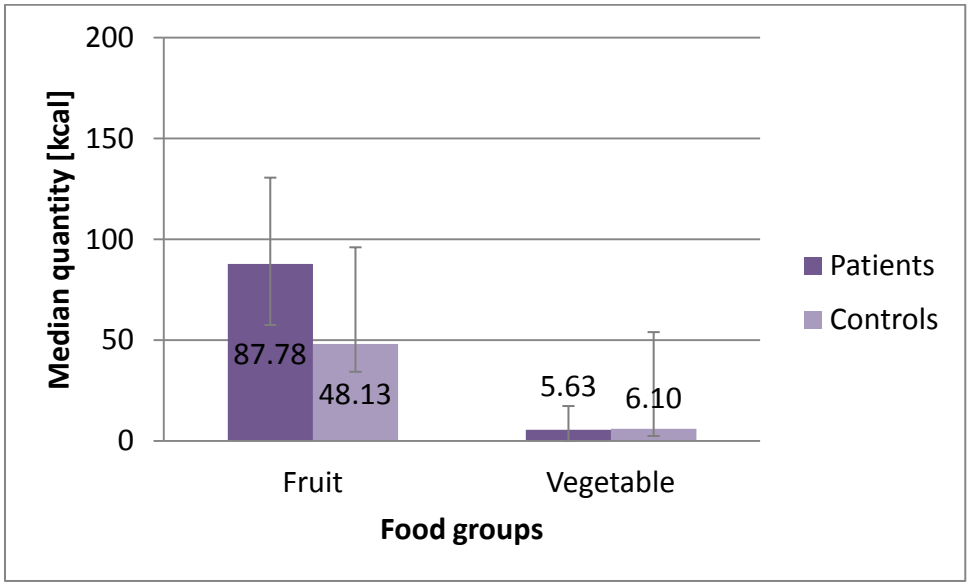

Figure 6. Median Daily Consumption of Fruit and Vegetables in Female Patients (n = 25) and Controls (n = 33) [*Error bars: 95 % CIs*]

Daily consumption of fruit in male individuals with bipolar disorder did not significantly differ from male individuals in the control group. Furthermore, there were no significant differences in consumption of vegetables or fiber intake.

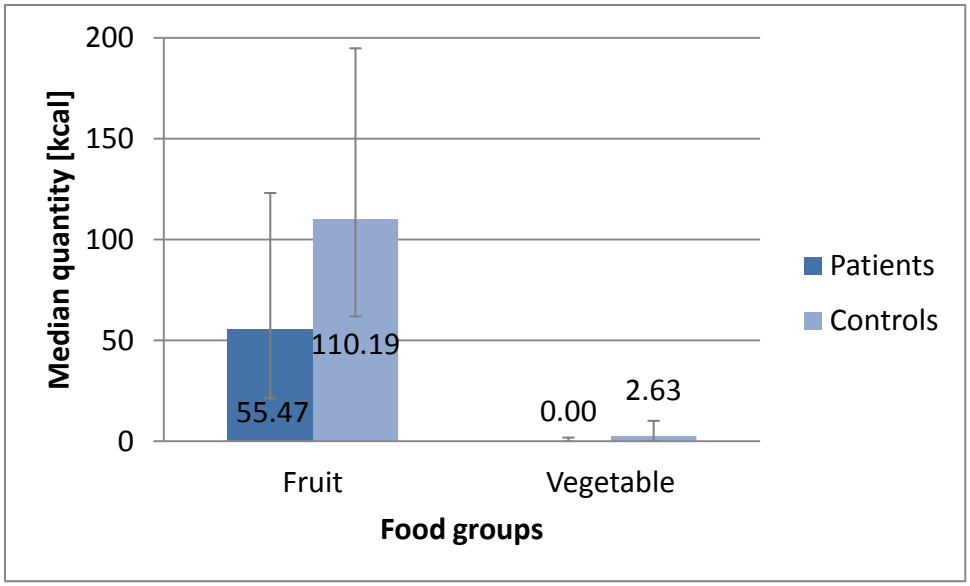

Figure 7. Median Daily Consumption of Fruit and Vegetables in Male Patients (n = 25) and Controls (n = 17) [*Error bars: 95 % CIs*]

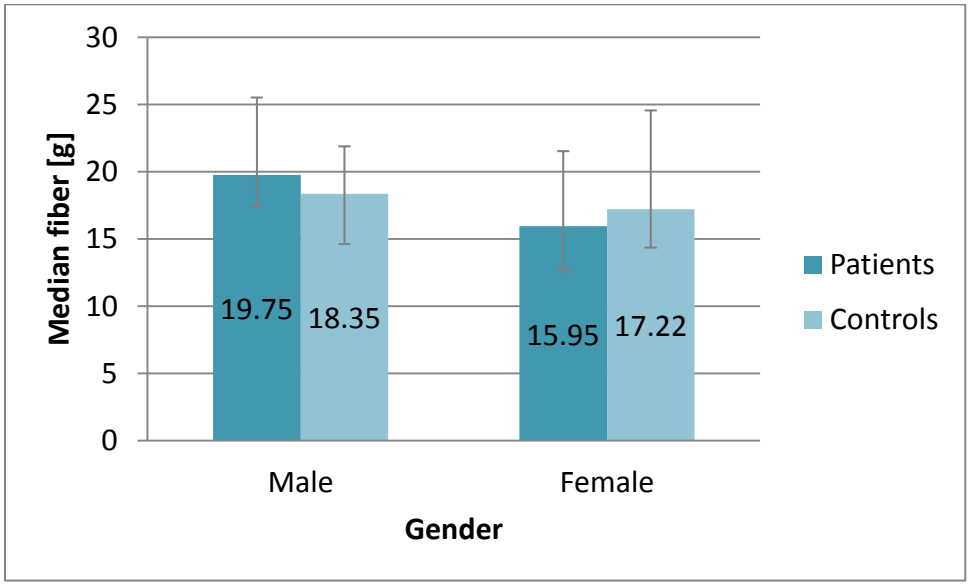

Figure 8. Median Daily Fiber Intake in Patients (n = 50) and Controls (n = 50) [*Error bars: 95 % CIs*]

3.3 Food craving

3.3.1 Food craving and bipolar disorder

Hypothesis 2a predicted that individuals with bipolar disorder would experience more food craving than control subjects.

Food craving in patients and controls was compared using the Mann-Whitney-U test (for test statistics see Table 7) due to the non-parametric distribution of the data.

Patients exhibited significantly more total food craving (*Mdn* = 67.00, *IQR* = 22.00) than controls (*Mdn* = 64.00, *IQR* = 16.00). Additionally, levels of craving for fat were significantly higher in the patient group (*Mdn* = 17.00, *IQR* = 9.00) than in the reference group (*Mdn* = 16.00, *IQR* = 8.00).

There were no significant differences between the two groups in the craving for sweets, carbohydrate, and fast food.

Table 7. Mann-Whitney-U Test Statistics for Group Differences in Food Craving

	U	***z***	***P***	***r***
Total craving	**826.00**	**- 1.96**	**.050**	**- .20**
Sweets craving	883.00	- 1.53	.127	- .16
Carbohydrate craving	1011.50	- 0.54	.592	- .06
Fat craving	**823.00**	**- 1.99**	**.047**	**- .21**
Fast food craving	862.50	- 1.69	.091	- .18

Note. N = 93

When this analysis was repeated separately for each gender no significant difference in total craving between female patients and female controls was observed. Additionally, both groups did not differ significantly in cravings for sweets, carbohydrate, fat, and fast food.

However, male patients (*Mdn* = 69.50, *IQR* = 18.00) did experience significantly more total food craving than controls (*Mdn* = 65.00, *IQR* = 22.00). Additionally, levels of sweets craving (*Mdn* = 21.00, *IQR* = 4.50 in patients; *Mdn* = 16.00, *IQR* = 6.00 in controls) and fat craving (*Mdn* = 22.00, *IQR* = 9.00 in patients; *Mdn* = 17.00, *IQR* = 10.00 in controls) were significantly higher in the patient group.

No significant difference between patients and controls in levels of craving for carbohydrate and fast food were observed. Mann-Whitney-U test statistics are presented in Table 8.

Table 8. Mann-Whitney-U Test Statistics for Group Differences in Food Craving in Males

	U	*z*	*P*	*r*
Total craving	**124.50**	**- 2.11**	**.035**	**- .33**
Sweets craving	**106.50**	**- 2.59**	**.010**	**- .40**
Carbohydrate craving	150.50	- 1.42	.156	- .22
Fat craving	**129.50**	**- 1.98**	**.048**	**- .31**
Fast food craving	170.00	- 0.91	.365	- .14

Note. N = 41

3.3.2 Food craving and psychotropic medication

Hypothesis 2b stated that patients taking psychotropic medication associated with carbohydrate craving (lithium, SGAs, and antiepileptic medication) would experience more carbohydrate craving than patients not taking this type of medication.

The comparison of levels of food craving between individuals who take lithium, second generation antipsychotics or antiepileptic medication was performed in the patient group only by using the Mann-Whitney-U test. Intake of psychotropic medication among patients is summarized in Table 10.

Table 9. Intake of Psychotropic Medication among Patients

Medication	***N***	***%***
Lithium	16	32
Second generation antipsychotic	30	60
Antiepileptic medication	16	32

Note. N = 50

Levels of carbohydrate craving in patients taking lithium did not significantly differ from individuals not taking this type of medication. Also, patients currently taking lithium did not experience more total craving or craving for sweets, fat, and fast food.

Levels of carbohydrate craving in individuals with bipolar disorder taking second generation antipsychotics did not significantly differ from individuals not taking this type of medication. Also, patients currently taking SGAs did not experience more total craving or craving for sweets, fat, and fast food.

Levels of carbohydrate craving in patients taking antiepileptic medication did not significantly differ from individuals not taking this type of drug. Also, patients currently taking antiepileptic medication did not experience more total craving or craving for sweets, fat, and fast food.

3.3.3 Food craving and consumption

Hypothesis 3 stated that individuals who exhibited higher levels of food craving would also consume a higher number of calories.

Spearman's correlation coefficient was computed to analyze relationships between food craving and consumption for patients and controls separately. Also, bias corrected and accelerated bootstrap 95 % confidence intervals were calculated.

No significant correlations between food craving and energy consumption were observed in the patient group.

In controls, the craving for sweets was significantly and negatively related to energy consumption from dinner. Furthermore, there was a significant relation between sweets craving and energy intake from midmorning snacks. In addition, significant negative relations between craving for carbohydrate and amount of energy consumed from late night snacks as well as craving for high fat foods and energy intake from afternoon snacks were observed. For correlation coefficients and 95 % confidence intervals refer to Table 10 and Table 11.

Table 10. Correlations between Food Craving and Energy Intake from Meals in Controls

	Energy total	Breakfast	Lunch	Dinner
Total food craving	.09 [- .161, .335]	.09 [- .195, .362]	.09 [- .219, .396]	- .15 [- .434, .141]
Sweets craving	- .08 [- .358, .191]	.21 [- .065, .451]	.26 [- .059, .517]	**- .44** [- .630, .- 195]**
Carbohydrate craving	- .17 [- .464, .144]	-.01 [- .289, .282]	.03 [- .267, .330]	- .11 [- .355, .151]
Fat craving	- .07 [- .330, .198]	- .13 [- .387, .152]	.19 [- .123, .467]	.21 [- .071, .476]
Fast food craving	- .10 [- .366, .173]	.05 [- .248, .335]	.17 [- .143, .455]	- .22 [- .499, .076]

*Note. N = 46, **p < .01. BCa bootstrap 95 % CIs in brackets.*

Table 11. Correlations between Food Craving and Energy Intake from Snacks in Controls

	Snacks total	Snack 1	Snack 2	Snack 3
Total food craving	- .16 [- .443, .149]	.11 [- .144, .360]	- .17 [- .409, .106]	- .22 [- .521, - .120]
Sweets craving	.11 [- .147, .373]	**.32* [.056, .555]**	.03 [- .212, .259]	.04 [- .264, .358]
Carbohydrate craving	- .11 [- .383, .192]	.24 [- .016, .475]	- .11 [- .391, .158]	**- .35* [- .593, - .048]**
Fat craving	- .24 [- .531, .082]	- .07 [- .368, .219]	- .17 [- .440, .116]	- .27 [- .564, .071]
Fast food craving	- .24 [- .510, .075]	- .14 [- .460, .223]	**- .37* [- .611, - .067]**	.05 [- .238, .324]

*Note. N = 46, * p < .05. BCa bootstrap 95 % CIs in brackets.*

In patients there was a significant relationship between the craving for sweets and both consumption of sweets and sucrose intake observed. For correlation coefficients and 95 % confidence intervals refer to Table 12.

These relations were not present in the control group.

Table 12. Correlations between Food craving and Intake of Sweets, Baked Goods, and Sucrose in Patients

	Sweets [kcal]	Baked goods [kcal]	Sucrose [g]
Total food craving	.12	.09	.08
	[- .206, .415]	[- .195, .382]	[- .254, .389]
Sweets craving	**.39****	.14	**.29***
	[.125, .619]	[- .171, .438]	**[- .019, .560]**
Carbohydrate craving	.09	.09	.10
	[- .212, .375]	[- .170, .375]	[- .217, .410]
Fat cravings	- .29	- .15	- .17
	[- .461, .193]	[- .600, .037]	[- .460, .175]
Fast food cravings	.13	.09	- .01
	[- .168, .432]	[- .177, .364]	[- .303, .300]

*Note. N = 46, *p < .05, **p < .01. BCa bootstrap 95 % CIs in brackets.*

3.3.4 Comparison between cravers and non-cravers

Hypothesis 4 stated that cravers would differ from non-cravers in distinct biological characteristics.

A median split was performed for the total FCI score as well as for the four subscales to obtain two groups each. Individuals with high levels of craving were labeled cravers, individuals with low levels non-cravers. Continuous variables were analyzed using independent t-tests; the comparison of categorical variables was performed using Pearson's chi-square tests.

Subsequently, separate analyses for patients and controls were done.

Total craving

There were significant differences regarding gender and smoking habits between cravers and non-cravers. Based on the odds ratio, the odds of men being cravers were 2.5 times higher than being non-cravers. The odds of smoking were 3.3 times higher in cravers than in non-cravers. Additionally, the waist-hip-ratio was significantly higher in cravers than in non-cravers.

Cravers and non-cravers did not differ significantly in BMI or age. Patients were not significantly more likely than controls to be cravers than. Demographic and biological characteristics of cravers and non-cravers are presented in Table 13.

Table 13. Demographic and Biological Parameters of Cravers and Non-Cravers

		Cravers (*n* = 45)	**Non-Cravers (*n* = 48)**			
		N (%)	***N (%)***	***χ^2 (df)***	***p***	***V***
Sex	Female	20 (44.44)	32 (66.67)	**4.65 (1)**	**.031**	**.22**
	Male	**25 (55.56)**	**16 (33.33)**			
Group	Patients	25 (55.56)	22 (45.83)	0.88 (1)	.349	.10
	Controls	20 (44.44)	26 (54.17)			
Smoking	Yes	**18 (40.00)**	**8 (16.67)**	**6.28 (1)**	**.012**	**.26**
	No	27 (60.00)	40 (83.33)			
		M (SD)	***M (SD)***	***t (df)***	***p***	***d***
Age [years]		44.39 (13.95)	46.14 (14.45)	0,57 (91)	.569	0.12
BMI [kg/m^2]		26.54 (4.24)	26.98 (6.86)	0.37 (91)	.715	0.08
Waist-hip-ratio		**0.93 (0.09)**	**0.89 (0.08)**	**- 2.26 (91)**	**.026**	**0.48**

In patients, the differences in sex and smoking habits were more pronounced. For men, the odds of being cravers were 4.6 times higher than being non-cravers. The odds of an individual smoking were 4.2 times higher in the craving group than in non-cravers. No significant difference in the use of psychotropic medication (lithium, SGAs, and antiepileptic medication) between cravers and non-cravers was observed.

In the patient group, the differences in age and BMI between cravers and non-cravers, albeit not significant, represented a medium-sized effect. There was a tendency for cravers to be younger and have a lower BMI than non-cravers.

For demographic and biological characteristics of cravers and non-cravers in the patient group see Table 14.

Table 14. Demographic and Biological Parameters of Cravers and Non-Cravers in Patients

		Cravers (*n* = 25)	**Non-Cravers (*n* = 22)**			
		N (%)	***N (%)***	***χ^2 (df)***	***p***	***V***
Sex	Female	8 (32.00)	15 (68.18)	**6.13 (1)**	**.013**	**.36**
	Male	**17 (68.00)**	**7 (31.82)**			
Lithium		8 (32.00)	8 (36.36)	0.10 (1)	.753	.05
SGA		18 (72.00)	11 (50.00)	2.40 (1)	.122	.23
Anticonvulsants		8 (32.00)	7 (31.82)	0.00 (1)	.989	.002
Smoking	Yes	**12 (48.00)**	**4 (18.18)**	**4.63 (1)**	**.031**	**.31**
	No	13 (52.00)	18 (81.82)			
		M (SD)	***M (SD)***	***t (df)***	***p***	***d***
Age [years]		43.26 (13.37)	50.48 (12.84)	1.88 (45)	.066	0.56
BMI [kg/m^2]		26.83 (4.38)	30.51 (8.32)	1.93 (45)	.060	0.58
Waist-hip-ratio		0.94 (0.11)	0.92 (0.09)	- 0.74 (45)	.463	0.02

Note. Abbreviation: Second generation antipsychotic (SGA).

Among controls, cravers (n = 20) differed significantly from non-cravers (n = 26) in their BMI, t (44) = - 2.03, p = .048, d = 0.62. In contrast to results in the patient group, cravers (M = 26.19, SD = 4.15) had a higher BMI than non-cravers (M = 23.99, SD = 3.19). Additionally, cravers (M = 0.93, SD = 0.07) had a significant higher waist-hip-ratio than non-cravers (M = 0.87, SD = 0.08), t (44) = - 2.50, p = .016, d = 0.81. No significant age or sex differences were observed between cravers and non-cravers in the control group. Controls from the craving group were also not significantly more likely to be smokers than non-craving controls.

Sweets craving

Across the whole sample no significant differences in sex, age or anthropometric parameters between sweets cravers and those who do not crave sweets were found. Also, sweet cravers were not more likely to be patients or smokers than non-cravers.

In patients there were also no significant differences between those two groups observed. Especially, sweets cravers and non-cravers did not differ in their intake of psychotropic medication.

In controls, there were no significant differences in sex between sweets cravers and non-cravers. Also, sweets cravers and non-cravers did not differ significantly in age. Mean BMI did not differ significantly between sweets cravers and non-cravers.

Carbohydrate craving

Across the whole sample no significant differences in sex, age or anthropometric parameters between carbohydrate cravers and non-cravers were found. Also, carbohydrate cravers were not more likely to be patients or smokers than non-cravers.

In patients there were also no significant differences between those two groups observed. Patients who were carbohydrate cravers did not differ from non-craving patients in sex, age or BMI. No significant differences in intake of psychotropic agents were observed.

In controls, there was a significant difference in age between carbohydrate cravers (M = 49.56, SD = 12.73) and non cravers (M = 39.17, SD = 16.89), t (44) = - 2.32, p = .025, d = 0.70. Albeit the difference in sex distribution (23.81 % of carbohydrate cravers were male compared to 48.00 % of non-cravers) was not significant, χ^2 (1) = 2.87, p = .090, V = .25), it represented a medium-sized effect. There was no significant difference in smoking habits.

Fat craving

Across the sample, fat cravers had a significant higher waist-hip ratio than non-cravers. However, no significant difference in BMI was observed.

Additionally, the percentage of males was significantly higher in the fat craving group than in the non-craving group. Based on the odds ratio, the odds of being a smoker were 3.8 times higher among fat cravers than non-cravers. For demographic and biological characteristics see Table 15.

Table 15. Demographic and Biological Parameters of Fat Cravers and Non-Cravers

		Fat cravers (*n* = 43)	**Non-Cravers (*n* = 50)**			
		N (%)	***N (%)***	***χ^2 (df)***	***p***	***V***
Sex	Female	19 (44.19)	33 (66.00)	**4.46 (1)**	**.035**	**.22**
	Male	**24 (55.81)**	**17 (34.00)**			
Group	Patients	23 (53.49)	24 (48.00)	0.28 (1)	.598	.06
	Controls	20 (46.51)	26 (52.00)			
Smoking	Yes	**18 (41.83)**	**8 (16.00)**	**1.73 (1)**	**.006**	**.29**
	No	25 (68.89)	42 (84.00)			
		M (SD)	***M (SD)***	***t (df)***	***p***	***d***
Age [years]		47.16 (14.45)	43.68 (14.84)	-1.14 (91)	.257	0.24
BMI [kg/m^2]		26.30 (5.69)	27.21 (5.77)	- 0.12 (91)	.906	0.02
Waist-hip-ratio		**0.94 (0.09)**	**0.89 (0.09)**	**-2.54 (91)**	**.013**	**0.54**

The only significant difference between fat cravers and non-cravers existent in the patient group was the higher amount of males in the fat craving group. Refer to Table 16 for demographic and biologic parameters as well as test statistics.

Table 16. Demographic and Biological Parameters of Fat Cravers and Non-Cravers in Patients

		Fat cravers (*n* = 23)	**Non-Cravers (*n* = 24)**			
		N (%)	***N (%)***	***χ^2 (df)***	***p***	***V***
Sex	Female	7 (30.43)	16 (66.67)	**6.17 (1)**	**.013**	**.36**
	Male	**16 (69.57)**	**8 (34.33)**			
Lithium		9 (39.13)	7 (29.17)	0.52 (1)	.547	.11
SGA		15 (65.22)	14 (58.33)	0.24 (1)	.627	.07
Anticonvulsants		7 (30.743)	8 (33.33)	0.05 (1)	.831	.03
Smoking	Yes	11 (47.83)	5 (20.83)	3.81 (1)	.051	.29
	No	12 (52.17)	19 (79.17)			
		M (SD)	***M (SD)***	***t (df)***	***p***	***d***
Age [years]		47.52 (14.75)	45.80 (12.41)	- 0.43 (45)	.667	0.13
BMI [kg/m^2]		27.28 (4.65)	29.77 (8.14)	1.28 (45)	.208	0.38
Waist-hip-ratio		0.94 (0.07)	0.92 (0.08)	- 0.95 (45)	.347	0.27

Note. Abbreviation: Second generation antipsychotic (SGA).

In controls, no significant difference in sex distribution between fat cravers and non-cravers was found. However, fat cravers differed significantly in their BMI from non-cravers

(M = 23.88, SD = 3.14), t (44) = - 2.30, p = .026, d = 0.70. Additionally, the mean waist-hip-ratio in the fat craving group (M = 0.93, SD = 0.07) was significantly higher than in the non-craving group (M = 0.87, SD = 0.08), t (44) = - 2.84, p = .007, d = 0.81. While the difference in smoking habits (35.00 % of cravers were smokers compared to 13.04 % of non-cravers) was not significant, χ^2 (1) = 3.66, p = .056, V = 0.28, it did represent a medium-sized effect.

Fast food craving

Fast food cravers were significantly younger than non-cravers. Furthermore there was a significantly higher amount of males and smokers in the fast food craving group. No significant differences in BMI and waist-hip-ratio were found. For demographic and biological parameters seeTable 17.

Table 17. Demographic and Biological Parameters of Fast Food Cravers and Non-Cravers

		Fast food cravers (n = 32)	**Non-Cravers (n = 61)**			
		N (%)	***N (%)***	***χ^2 (df)***	***p***	***V***
Sex	Female	11 (34.38)	41 (67.21)	**9.18 (1)**	**.002**	**.31**
	Male	**21 (65.62)**	**20 (32.79)**			
Group	Patients	19 (59.38)	28 (45.90)	1.52 (1)	.217	.13
	Controls	13 (40.62)	33 (54.10)			
Smoking	Yes	**14 (43.75)**	**12 (19.67)**	**6.04 (1)**	**.014**	**.26**
	No	18 (56.25)	49 (80.33)			
		M (SD)	***M (SD)***	***t (df)***	***p***	***d***
Age [years]		**38.03 (13.91)**	**49.10 (13.71)**	**3.68 (91)**	**< .001**	**0.81**
BMI [kg/m^2]		26.27 (4.30)	27.03 (6.36)	0.60 (91)	.548	0.13
Waist-hip-ratio		0.92 (0.10)	0.91 (0.09)	-0.72 (91)	.476	0.16

Results in the patient group mirrored those observed in the whole sample. Fast food craving patients tended to be younger, male, and smokers. No differences in psychotropic medication intake or anthropometric parameters were observed. Demographic and biological characteristics are presented in Table 18.

Table 18. Demographic and Biological Parameters of Fast Food Cravers and Non-Cravers in Patients

		Fast food cravers (n = 19)	**Non-Cravers (n = 28)**			
		N (%)	***N (%)***	***χ^2 (df)***	***p***	***V***
Sex	Female	6 (31.58)	17 (60.71)	**3.85 (1)**	**.050**	**.29**
	Male	**13 (68.42)**	**11 (39.29)**			
Lithium		6 (31.58)	10 (35.71)	0.09 (1)	.769	.04
SGA		13 (68.42)	16 (57.14)	0.61 (1)	.435	.11
Anticonvulsants		7 (36.84)	8 (28.57)	0.36 (1)	.551	.09
Smoking	Yes	**10 (52.63)**	**6 (21.43)**	**4.91 (1)**	**.027**	**.32**
	No	9 (47.37)	22 (78.57)			
		M (SD)	***M (SD)***	***t (df)***	***p***	***d***
Age [years]		**39.99 (14.88)**	**51.16 (10.47)**	**3.03 (45)**	**.004**	**0.92**
BMI [kg/m^2]		27.07 (4.45)	29.56 (7.81)	1.25 (45)	.216	0.38
Waist-hip-ratio		0.92 (0.11)	0.94 (0.08)	0.44 (45)	.659	0.21

Note. Abbreviation: Second generation antipsychotic (SGA).

Analogously, among controls there was also a significant difference in sex distribution between fast food cravers (n = 13) and non-cavers (n = 33), χ^2 (1) = 4.70, p = .030, V = .32. In the craving group 61.54 % of individuals were male compared to 27.27 % in the non-craving group. Additionally, individuals in the fast food craving group (M = 35.17, SD = 12.37) tended to be younger than non-cravers (M = 47.35, SD = 15.91), t (44) = 2.48, p = .017, d = 0.83. No significant differences in smoking habits between the two groups were found.

3.4 Summary of results

In Table 19 a brief overview of the results is presented.

Table 19. Summary of Results

Hypotheses		**Confirmed (yes –no)**	**Details**
1a	Energy and macronutrient intake	no	*In male patients only: higher energy intake from breakfast; in male patients higher protein intake*
1b	Consumption of sweets	no	*No difference in consumption of sweets and baked goods*
1c	Consumption of fruit and vegetable	no	*No difference in consumption of fruit and vegetable*
2a	**Food craving and bipolar disorder**	**yes**	***More total food craving and craving for fat in patient; more craving for sweets in male patients***
2b	Food craving and psychotropic medication	no	*No differences in levels of food craving*
3	**Food craving and consumption**	**yes**	***In patients relation between craving for sweets and consumption of sweets and sucrose; in controls mostly negative relations between craving and consumption***
4	**Characteristics of cravers and non-cravers**	**yes**	***Tendency for cravers to be male and smokers***

4 DISCUSSION

The objective of this diploma thesis was to further explore eating behavior and the phenomenon of food craving in patients with bipolar disorder. In addition to a brief demographic, biological, and clinical characterization of the study sample differences in energy intake as well as macronutrient consumption between the clinical collective and reference subjects were assessed. Furthermore, energy intake through sweets and baked goods as well as sucrose intake were investigated. Also, consumption of energy from fruit and vegetable and intake of dietary fiber were assessed.

To evaluate the phenomenon of food craving in bipolar disorder levels of craving in patients were compared to those in controls and a possible relationship between craving and consumption was investigated. Particular attention was paid to associations between craving and the intake of psychotropic medication. Lastly, in an attempt to define some characteristic features of food cravers demographic and biological parameters of two groups of individuals with high and low craving levels, respectively, were compared.

4.1 Energy and macronutrient intake

Hypothesis 1a stated that individuals with bipolar disorder would consume a higher amount of macronutrients and have a higher daily energy intake than reference subjects.

For the most part, this hypothesis could not be confirmed. Female individuals with bipolar disorder did not differ from female controls in intake of overall reported daily energy nor did they reportedly consume significantly more energy for any given meal. The same was mostly true for male participants with the exception that male patients reportedly consumed more energy for breakfast than male control subjects.

Conversely, a difference in reported consumption of macronutrients was only found among male participants but not in female participants. Male patients did significantly consume more protein than males in the control group. No differences in intake of fat or carbohydrate were found.

Contrary to expectations, there seem to be only few differences in energy and macronutrient intake between the clinical collective and the control group. These results are

somewhat in accordance with previous research by Bly et al. (2014). Despite the fact that bipolar individuals did have healthier dietary habits (lower total energy intake as well as consumption of less fat and carbohydrate), they exhibited more metabolic risk factors than reference subjects. Analogously, in the present sample, bipolar individuals did have a higher BMI, higher levels of triglycerides, and lower levels of HDL than controls despite reportedly similar food choices among the two groups.

Overall, reported mean daily energy intake in the sample did not meet D-A-CH recommendations (Deutsche Gesellschaft für Ernährung, Österreichische Gesellschaft für Ernährung, Schweizerische Gesellschaft für Ernährung, Schweizerische Gesellschaft für Ernährungsforschung, Schweizerische Vereinigung für Ernährung, 2000). Assuming a PAL of 1.6, for adults between the ages of 25 and 51 these recommendations are set at 2800 kcal and 2100 kcal per day for males and females, respectively. In the age group between 51 and 65 a mean daily energy intake of 2500 kcal for men and 2000 for women is proposed. Especially male participants in both, patient group and control group, reported considerably lower energy intakes than suggested by these guidelines.

Energy requirements of the body are in large parts covered by the consumption of fat and carbohydrate and, to a slightly lesser extent, protein (Deutsche Gesellschaft für Ernährung, 2011). While reported consumption of fat and protein in this sample did meet and, in part, succeeded the recommended daily intakes this was not the case for carbohydrates. Daily carbohydrate intake should amount to at least 50 % of total energy (Deutsche Gesellschaft für Ernährung, 2011) or about 270 g for women and 340 g for men (Deutsche Gesellschaft für Ernährung, 2007). Study participants in both groups reportedly ate considerably less than suggested by these guidelines. This low reported carbohydrate intake was not paralleled by an accordingly high intake of fat (and protein) and is therefore the likely reason for overall low energy consumption in this investigation.

Hypothesis 1b stated that individuals with bipolar disorder would consume more calories from sweets and baked goods, as well as a higher amount of sucrose than control subjects.

The results of this investigation however, were not consistent with previous research that suggested a higher intake of sweets, cakes, and sucrose in bipolar individuals (Elmslie et al., 2001). In the present sample no differences in reported energy intake from sweets or baked goods between patients and controls of both sexes could be found. Additionally,

patients did not report consuming a higher amount of sucrose than controls. It has to be noted that the food groups “sweets” and “baked goods” (cakes, tarts, pastries, and biscuits) may not encompass every single sweet food reported. It is possible that a dessert consumed by a participant is categorized in another food group of the BLS. Overall, however, both food groups are accurate representations of reported consumption of the foods of interest. Reported consumption of both sweets and cakes was rather low across the whole sample, which holds also true for intake of sucrose which shouldn’t exceed 10 % of total energy intake (Elmadfa et al., 2012).

Hypothesis 1c stated that individuals with bipolar disorder would consume fewer calories from fruits and vegetables, as well as less dietary fiber than control subjects. This could not be confirmed by the present investigation. There were no differences in the reported amount of energy consumed from fruit and vegetable between patients and controls of both sexes. The two groups did also not differ in their daily intake of dietary fiber.

As with the food groups sweets and baked goods, the food groups fruit and vegetable do not contain all non-animal products consumed. Composite dishes containing mainly vegetable products are subsumed in its own category and may account for a considerable amount of energy intake from fruit and vegetable. Therefore, while reported intake of products from these two groups is low across the whole sample, this may not represent overall consumption.

However, it has to be noted, that reported daily intake of dietary fiber which is in large parts derived from vegetable and fruit, is low across the whole sample and does not meet recommendations which are set at 30 g per day (Elmadfa et al., 2012). This may be indicative of the overall low consumption of vegetable and vegetables products as well as fruit and fruit products in this sample.

4.2 Food craving

Hypothesis 2a stated that individuals with bipolar disorder would experience more food craving than control subjects, especially craving for carbohydrates and sweets.

It was demonstrated that patients in this study sample did experience more total food craving and more craving for foods high in fat than controls. When analyzing both sexes

separately these differences did only subsist among male participants. In fact, no differences in levels of craving on any of the four subscales were found between female patients and female reference subjects. However, male patients did also experience more craving for sweets than males in the control group.

Across the whole sample male individuals did experience more craving for foods high in fat as well as fast food than females.

These findings may at first appear contradictory to results of previous research. Across the existing literature the craving for and subsequent consumption of carbohydrate has received the most attention and it is its association with obesity, negative affective states and intake of psychotropic medication that lead to the construction of this hypothesis. While male patients did exhibit higher levels of sweets craving, no associations between bipolar disorder and carbohydrate craving have been observed. However, it has been demonstrated that the carbohydrate-rich foods that individuals crave are mainly sweet, with sugar being the predominant carbohydrate and also contain high amounts of fat (Drewnovsky, Kurth, Holden-Wiltse & Saari, 1992). In fact, according to its original definition the term "carbohydrate craving" referred to "a ravenous appetite" for chocolates, cake, pastry, and ice cream that occurred as a side effect of the antidepressant amitriptyline (Paykel, Mueller & de la Vergne, 1973). All these food items are subsumed under the sweets category of the FCI rather than the carbohydrate category so these results may in fact be a manifestation of the previously described phenomenon.

The findings of this investigation regarding higher levels of craving for fat in the patient group are consistent with existing literature. Research has suggested that cravings for foods low in fat are relatively rare and that fat cravings are a frequent occurrence (Pelchat, 1997) and associated with higher BMI (White et al., 2002). Furthermore, the preference for foods high in fat (or fat and protein) is presumed to be of higher prevalence in male individuals (Drewnovsky et al., 1992). In an investigation of food preferences in obese individuals by Drewnovsky et al. (1992) women did list foods high in carbohydrate (and fat) and sweet foods as their favorite while men preferred high fat foods and foods high in fat and protein. This was also true in this sample; male participants experienced significantly higher craving levels on the fat and fast food subscales which both include high fat foods like meat dishes and savory snacks.

Despite the apparent sex difference regarding the craving for fat, the significant association may be the one between fat preference and obesity. Previous research (Mela &

Sacchetti, 1991) has shown a relationship between the sensory preference for high fat food and percentage of body fat. However, a relationship between fat preference and fat consumption did not emerge. The results of the present investigation are in consistence with these findings. Although levels of craving for fats did not correlate with consumption of high fat foods, the fact that individuals with bipolar disorder exhibit higher rates of obesity may account for their increased levels of fat craving.

Hypothesis 2b stated that patients taking psychotropic medication associated with carbohydrate craving (lithium, second generation antipsychotics, and antiepileptic agents) would experience more carbohydrate craving than individuals not taking this type of medication. This hypothesis had to be rejected as there were no differences in levels of carbohydrate craving between patients taking lithium, SGAs or an antiepileptic agent and those not taking this kind of drugs. Additionally, no differences in levels of total craving or craving on any of the other three subscales were found.

Mood stabilizers and SGAs used in the treatment of bipolar disorder have been associated with weight gain facilitated, in part, by stimulation of appetite and inducing binge eating or craving for carbohydrate-rich foods (Kluge et al, 2007; Virk et al., 2004).

These side effects are mainly occurrences of acute treatment; they arise usually within the first few weeks (Kluge et al., 2007). Since food cravings and binge eating seem to be most pronounced at the beginning of treatment, the fact that the patient cohort in this investigation was rather heterogenic regarding illness duration and length of treatment could obscure possible relationships between psychotropic medications and cravings. Secondly, medication intake was only broadly categorized into three groups (lithium, SGAs, and antiepileptic agents) without taking into consideration exact substances or individuals taking a combination of any of these drugs or additional medication like antidepressants. Since the underlying mechanisms of food craving are believed to involve the serotonergic system (Ventura et al., 2014), antidepressants like serotonin reuptake inhibitors could counteract the effect of these medications and actually reduce food cravings (Kluge et al., 2007).

Hypothesis 3 stated that individuals who exhibit higher levels of food craving would also consume a higher number of calories.

In patients, levels of total food craving were neither associated with a higher reported total energy consumption nor higher energy intake at any given meal.

In controls, there was a negative relation between the amount of reported energy consumed for dinner and craving for sweets. Furthermore, in controls, several negative correlations between reported energy intake for snacks and subscale levels of craving were found. Although this is consistent with several studies that have found a relationship between food craving and dietary restraint or restricted eating (Hill, 2007; Lafay et al., 2011) the design of this investigation does not allow for determination of the direction of this effect.

In this investigation two notable relations between craving and reported consumption in individuals with bipolar disorder emerged. The craving for sweets was correlated with both higher reported intake of energy from sweets and intake of sucrose. Although, there were no differences in reported consumption of sweets and sucrose between the two groups observed, the fact that this relationship was only present in patients suggests the phenomenon of food craving may be of clinical importance in bipolar disorder and is a possible contributing factor to the onset of overweight in this collective. It may be that the consumption of sweet foods (that are mostly high in sugar and fat) among patients is predominantly triggered by a craving for those foods. Therefore avoiding these foods and, subsequently, the implementation of dietary recommendations may be especially challenging in this population.

Hypothesis 4 stated that cravers differ from non-cravers in distinct demographic and biological characteristics like sex, age or BMI.

With the exception of the cravings for sweets and carbohydrates where no differences between cravers and non-cravers were found, craving was associated with male sex in this sample. This is in contrast to most existing literature, which suggests that food craving is more prevalent in women than in men (Hill, 2007; Lafay et al., 2001; Zellner, Garriga-Trillo, Rohm, Centeno & Parker, 1999). However, the higher percentages of male individuals among fat cravers and fast food cravers are consistent with the results by Drewnovsky et al. (1992) who noted higher levels of craving for fat and protein in male obese individuals.

The fact that cravers tended to be more likely to be smokers than non-cravers may be in part explained by the concept of a “cue-reactive” phenotype that was introduced by Styn et al. (2013). In their sample of 146 smokers cue-induced high levels of craving for cigarettes were associated with equally high post-cue cravings for highly palatable foods like chocolate. Although in the present investigation an intentional conditioning of cravings was not attempted, the theory that these cravings share pathophysiological pathways may be expanded to cravings that are not a reaction to a presented cue. An individual that experiences high

levels of cravings for fast foods may therefore also be likely to experience a strong craving for cigarettes which may prevent them from quitting smoking. The exposure of a respective cue may not only result in cravings for food as well as illicit drugs or nicotine, it may also lead to the activation of the brain's reward regions. Research has established the effect of nicotine on the dopaminergic system and the subsequent reinforcement of addictive behaviors (Picciotto & Corrigall, 2002) and the same mechanisms have been discussed in the context of food cravings (Ventura et al., 2014).

4.3 Limitations

First and foremost, this diploma thesis has to be regarded as a preliminary investigation that aims at providing an overview of dietary habits in individuals with bipolar disorder. There are a multitude of nutritional variables that have not been considered in this investigation for one of its objectives was to point out possible lines of further research.

Similar to all research relying on self-reported food intake to assess eating habits, diet, and other variables related to nutrition, the misreporting of energy intake poses a considerable limitation to this investigation. For this study a cut-off of PAL of 1.55 was established to identify diet records that did not meet minimum energy requirements (Livingstone & Black, 2003). With regards to this cut-off, 83% of all individuals in this sample were considered energy-underreporters. Although this is consistent with literature that has classified up to 85% of various study populations as underreporters (Maurer et al., 2006), the method arriving at this results is not undisputed. On the one hand, a PAL of 1.55 may be considered a conservative value for normally active individuals. On the other hand, it is suggested that a blanket cut-off of 1.55 is only able to identify one half of all underreporters (Black, 2000).

There is evidence that underreporters tend to report lower intakes of foods that are generally considered "bad" like cake, cookies or candies (Livingstone & Black, 2003). Therefore there is reason to believe that the food groups sweets and baked goods that were investigated may be considerably affected by it. While it is suggested that there is an overall tendency to over-report "good" foods like meat, fish, vegetables, and fruit (Livingstone & Black, 2003), it has also been demonstrated that underreporters seem to actually consume less fruit and vegetables (Becker, Foley, Shellley & Gibney, 1999). Therefore, all data regarding

nutritional intake has to be interpreted with caution and with the high number of individuals that misreport energy intake in mind.

Since it is established that diet and eating behavior are influenced by a variety of parameters, a comprehensive analysis should also encompass factors like physical activity and comorbid eating disorders. In addition, socioeconomic determinants associated with bipolar disorder like low education, financial burden or overall poor psychosocial functioning (Fagiolini et al., 2003) may also influence nutritional behavior. Individuals may not have the means for a healthy, balanced diet (e.g. fresh fruit and vegetables, whole grains or fish) or, simply, cannot afford to buy the food they want to buy. Additionally, a lower level of education is likely to be associated with correspondingly lower levels of "nutritional knowledge", that is, patients may not know what constitutes a healthy diet or have the required cooking skills. SES is therefore a factor that bears consideration in analyses of nutritional behavior.

Due to the episodic nature of bipolar disorder, there may be great intrapersonal variance in eating behavior. An individual's diet in times of euthymia may differ dramatically from his or her food choices during depressive or manic states. Since this investigation only included euthymic individuals it may have not depicted the whole spectrum of dietary habits and food consumption in individuals with bipolar disorder.

To assess the phenomenon of food craving in its entirety past and present dieting behavior, mood states associated with cravings, and menstrual cycle in females would have to be taken in consideration.

4.4 Conclusion

Although, the results of this investigation suggest that factors other than diet and eating behavior are primary contributors to the development and maintenance of overweight and obesity in individuals with bipolar disorder, there is in fact further evidence for the complex underlying mechanisms of this illness and its comorbid conditions. Most likely, there are not one but several factors involved that may also vary from individual to individual. Therefore, eating behavior and related parameters should be the subject of further research.

This diploma thesis has shown that the phenomenon of food craving may be of clinical importance in individuals with bipolar disorder and is possible to play a role in the

development of overweight and obesity in this collective. While the focus of research has been the craving for carbohydrates and sweets the craving for high fat foods prevalent in men warrants further investigations.

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APPENDIX

Appendix A: 4day-Estimated Food Record

Appendix B: Food Craving Inventory

4 Tage-Protokoll

In der vorliegenden Erhebung werden Sie gebeten, Ihre Ernährung 4 Tage lang zu protokollieren.

Zur Erklärung:

Im Feld
„Was haben Sie zur jeweiligen Mahlzeit gegessen und getrunken“
beschreiben Sie bitte möglichst genau die Lenensmittel und Getränke wie folgt:
- Nicht *Brot* sondern: z. B.: Schwarzbrot, Vollkornbrot, Knäckebrot…
- Nicht *Käs*e sondern: z. B.: Emmentaler 45%, Schmelzkäse 15%
- Nicht *Wurst* sondern: z. B.: Salami, Schinken, Wiener, Extrawurst…
- Beispiele für Speisen: Nudelsuppe, Forelle blau, Spaghetti mit Fleischsauce…
- Beispiele für Getränke: Kafffee mit Milch und Zucker, Mineralwasser…

Im Feld
„ungefähre Menge“
Tragen Sie bitte ein:
z. B.:
- 1 Scheibe Schwarzbrot, Vollkornbrot, … g Emmentaler45%, … g Schmelzkäse 15%,… g Salami, … g oder … Scheibe(n) Schinken, Extrawurst…
- 1 Teller Nudelsuppe, … g. Forelle blau, 1 Teller Spaghetti mit Fleischsauce…
- ¼ l Mineralwasser, 1 Tasse Kaffee mit Milch und Zucker…
- 1 großes/mittleres/kleines Stück Apfel, Kuchen, Auflauf…

Wenn Sie sich an die Mengen nicht mehr genau erinnern können, so schreiben Sie bitte: *„viel“, „mittel“, „wenig“* bzw. *„große“, „mittlere“, „kleine“ Portionen*

Wenn Sie zu einer Mahlzeit nichts gegessen/getrunken haben, dann machen Sie einfach einen Strich!

Name:

Probanden-ID:

Geschlecht:

Körpergröße:

Körpergewicht:

Alter:

Leiden Sie an Magen-Darmproblemen? **o ja** **o nein**

Wenn ja, welche:

……
……...

Nehmen Sie Nahrungsergänzungen zu sich? **o ja** **o nein**

Wenn ja, welche:

Vitamine:

- o Multivitaminmischung
- o Vitamin B-Komplex alleine
- o Vitamin C alleine
- o Vitamin E alleine
- o Sonstige, nämlich…….

Mineralstoffe:

- o Mineralstoffmischung
- o Eisen alleine
- o Calcium alleine
- o Magnesium alleine
- o Sonstiges, nämlich……

Eiweißergänzungen: **o ja** **o nein**
Kohlenhydratergänzungen: **o ja** **o nein**
Sonstiges,
nämlich…….....

Nennen Sie nun bitte den/die Namen der Ergänzungen, die Sie

nehmen:

✍……
……...

TAG 1

Mahlzeit	**Was haben Sie zur jeweiligen Mahlzeit gegessen und getrunken?**	**ungefähre Menge**
Frühstück Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Vormittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Mittagessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

Nachmittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Abendessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Spätmahlzeit Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

War das typisch für Ihre Ernährungsgewohnheiten?

o ja o nein

Wenn nein, was war der Grund?
o Es war Wochenende und da sieht meine Ernährung ein wenig anders aus
o Anderer Grund:

✍……
……

TAG 2

Mahlzeit	**Was haben Sie zur jeweiligen Mahlzeit gegessen und getrunken?**	**ungefähre Menge**
Frühstück Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Vormittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Mittagessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

Nachmittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Abendessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Spätmahlzeit Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

War das typisch für Ihre Ernährungsgewohnheiten?

o ja o nein

Wenn nein, was war der Grund?
o Es war Wochenende und da sieht meine Ernährung ein wenig anders aus
o Anderer Grund:

✍……
……

TAG 3

Mahlzeit	**Was haben Sie zur jeweiligen Mahlzeit gegessen und getrunken?**	**ungefähre Menge**
Frühstück Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Vormittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Mittagessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

Nachmittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Abendessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Spätmahlzeit Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

War das typisch für Ihre Ernährungsgewohnheiten?

o ja o nein

Wenn nein, was war der Grund?
o Es war Wochenende und da sieht meine Ernährung ein wenig anders aus
o Anderer Grund:

✍……
……...

TAG 4

Mahlzeit	**Was haben Sie zur jeweiligen Mahlzeit gegessen und getrunken?**	**ungefähre Menge**
Frühstück Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Vormittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Mittagessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

Nachmittagsjause Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Abendessen Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	
Spätmahlzeit Uhrzeit: Ort:	Bitte die Getränke nicht vergessen!!!	

War das typisch für Ihre Ernährungsgewohnheiten?

o ja o nein

Wenn nein, was war der Grund?
o Es war Wochenende und da sieht meine Ernährung ein wenig anders aus
o Anderer Grund:

✍……
……...

Fragebogen zum „Food-Craving“

Dieser Fragebogen hat zum Ziel, das intensive Verlangen nach einem bestimmten Nahrungsmittel (Food-Craving), abzuschätzen. Bitte vermerken Sie, wie oft Sie im vergangenen Monat das intensive Verlangen nach folgenden Nahrungsmitteln verspürt haben

Familienname: ..... Vorname:.....

		Nie	selten	manchmal	häufig	fast täglich
1.	Backhendl	☐	☐	☐	☐	☐
2.	Bratwurst, Frankfurter, Hotdog	☐	☐	☐	☐	☐
3.	Schweinsbraten	☐	☐	☐	☐	☐
4.	Frittierter/gebackener Fisch	☐	☐	☐	☐	☐
5.	Speck	☐	☐	☐	☐	☐
6.	Wienerschnitzel	☐	☐	☐	☐	☐
7.	Wurstwaren	☐	☐	☐	☐	☐
8.	Steak	☐	☐	☐	☐	☐
9.	Kekse	☐	☐	☐	☐	☐
10.	Schnitten, Schokowaffeln	☐	☐	☐	☐	☐
11.	Zuckerln	☐	☐	☐	☐	☐
12.	Schokolade	☐	☐	☐	☐	☐
13.	Torte	☐	☐	☐	☐	☐
14.	Kuchen	☐	☐	☐	☐	☐
15.	Süßes Gebäck (Plunder, Striezel,…)	☐	☐	☐	☐	☐
16.	Eis	☐	☐	☐	☐	☐
17.	Semmeln	☐	☐	☐	☐	☐
18.	Palatschinken oder Waffeln	☐	☐	☐	☐	☐
19.	Biskuit	☐	☐	☐	☐	☐
20.	Toastbrot	☐	☐	☐	☐	☐
21.	Reis	☐	☐	☐	☐	☐
22.	Ofenkartoffel	☐	☐	☐	☐	☐
23.	Nudeln	☐	☐	☐	☐	☐
24.	Cerealien (Cornflakes,…)	☐	☐	☐	☐	☐
25.	Hamburger oder Kebab	☐	☐	☐	☐	☐
26.	Pommes frittes	☐	☐	☐	☐	☐
27.	Chips, Erdnüsse, Erdnusslocken,…	☐	☐	☐	☐	☐
28.	Pizza	☐	☐	☐	☐	☐

Vielen Dank!