THE USE OF ESM TO COLLECT REAL-TIME DATA ON EMOTION AND CONTEXTUAL FACTORS IN RELATION TO PROBLEMATIC EATING BEHAVIOUR IN POST-BARIATRIC PATIENTS

A longitudinal research methodology

Master Thesis

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Abstract

Background: Nowadays, bariatric surgery is the most effective intervention to obtain sufficient weight loss in patients experiencing morbid obesity, showing promising results in reducing the risk of comorbidities and chronic conditions. In order to maintain lasting weight loss, it is of great importance that patients adhere to lifestyle rules recommended postoperatively. Despite the effectiveness of bariatric surgery, post-bariatric patients are not always able to maintain healthy behavioural changes, resulting in weight gain. Eating behaviour appears to be an important aspect for behavioural change in post-bariatric patients. Moreover, emotions and contextual factors play a great role in problematic eating behaviour. The current study aims to investigate the influence of emotions and contextual factors in relation to problematic eating behaviours in post-bariatric patients. In addition, research has been conducted into the usability of an ESM application to see whether this tool can possibly be integrated into bariatric aftercare.

Methods: An Experience Sampling Study was conducted among patients who underwent bariatric surgery in 2022 in Hospital Group Twente (ZGT). The application Ethica investigated emotions (anger, hunger and stress), contextual factors (place and activity) and problematic eating behaviours (loss of control (LOC) eating, craving, grazing and dietary relapse) in post-bariatric patients (*N*= 18). In a 14-day ESM study, respondents had to complete six questionnaires a day that were sent at semi-random times. Linear Mixed Models (LMMs) with a random intercept were used for the statistical analysis. Furthermore, insight was obtained into the usability of Ethica from a patients' perspective by conducting semi-structured interviews (*N*= 5).

Results: Current research showed that hunger was associated with craving (*B*=.093, *p*<.001) and stress was associated with grazing (*B*=-.008, *p*=.004). Anger and contextual factors were not associated with LOC eating, craving and grazing (*p*>.05). In addition, low frequencies of problematic eating were found. LOC eating occurred 7 times, dietary relapse occurred 45 times and grazing occurred 13 times during the 14-day ESM study with 18 participants. The semi-structured interviews showed that the self-reported ESM questionnaires made patients more aware of their eating behaviour.

Conclusion: Present study confirms that there is an association between hunger and craving and stress and grazing in post-bariatric patients. Current study found no associations between contextual factors and problematic eating behaviour. The semi-structured interviews indicated that respondents were positive about the usability of the application after surgery and visioned that Ethica could be of added value for bariatric patients in the postoperative phase. This offers perspective for the use of an innovative technology to optimize the aftercare of bariatric patients.

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Table of Contents

1. Introduction

1.1 Prevalence obesity and bariatric surgery

With tripled rates of prevalence in recent decades, obesity has been recognized as a serious public health problem due to the various health risks associated with this chronic disease (Swinburn et al., 2011). In 2016, 1.9 billion people aged 18 years or older were overweight, of which 650 million were classified as obese (*Obesity and Overweight*, 2021). According to the World Health Organization (WHO) (*Obesity*, n.d.), obesity is defined as "abnormal or excessive fat accumulation that presents a risk to health." In the Netherlands, one in three Dutch residents was moderately or severely overweight 30 years ago. Currently, the percentage of individuals who are overweight in the Netherlands has risen to 50% (*Overgewicht | Leeftijd En Geslacht Volwassenen | Volksgezondheid En Zorg*, n.d.).

The Body Mass Index (BMI) is a measure to classify individuals as either underweight, normal, overweight, obese and extremely obese. An adult is classified as obese if the BMI is greater than or equal to 30 kg/m² (Weir & Jan, 2021). A BMI greater than or equal to 25 kg/m² increases the risk of comorbidities such as cardiovascular diseases, cancer, diabetes mellitus type 2, obstructive sleep apnea, and joint complaints, which increases the risk of an early death (*Overgewicht | Leeftijd En Geslacht Volwassenen | Volksgezondheid En Zorg*, n.d.). Due to the underlying comorbidities and lower life expectancy, obesity is associated with a reduced quality of life (Stephenson et al., 2021).

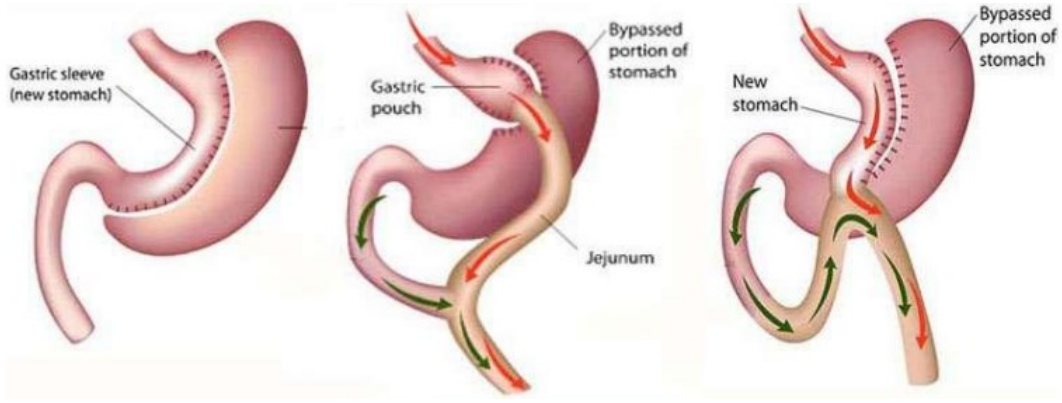
The cause of obesity is mainly an unbalanced energy intake and expenditure in combination with an inactive lifestyle and excessive food intake (Blüher, 2019; Jia & Liu, 2021). In other words, obese patients have an energy imbalance in which too many calories are absorbed and too few calories are expended (Sharma & Padwal, 2010). However, research shows that other factors may contribute to the development of obesity, such as genetics, emotional and sociodemographic influences (Endalifer & Diress, 2020; S. P. Goldstein et al., 2018). To limit and solve these factors that may contribute to excessive weight gain, various treatments and interventions are available to

ensure a healthier lifestyle. Standard interventions for obesity include interventions based on diet, exercise and pharmacological treatment ((UK) & (UK), 2006; Booth et al., 2014, 2015; Meany et al., 2014). Bariatric surgery is indicated when adequate weight loss cannot be achieved by standard interventions. Patients are eligible for bariatric surgery when they are classified with severe or morbid obesity (BMI>40kg/m²) or severe obesity (BMI>35kg/m²) with associated comorbidities (Bjørklund et al., 2020).

Nowadays, bariatric surgery is the most successful and durable intervention to obtain sufficient weight loss in patients with severe obesity and reduces the risk of comorbidities and other chronic conditions (Amundsen et al., 2016; S. P. Goldstein et al., 2018; Newman et al., 2021). Currently, three different types of surgical procedures on bariatric patients are performed in the Netherlands, consisting of the Sleeve Gastrectomy (SG), the Roux-en-Y Gastric Bypass (RYGB) and the Mini Gastric Bypass (MGB) (Weledji, 2016). Bariatric surgery ensures that food intake is limited by reducing the size of the stomach pouch (Campos et al., 2008). In addition, a part of the small intestine is skipped when performing a RYGB- and MGB-surgical procedure, so that the body is less able to absorb nutrients into the bloodstream. This results in a reduced absorption capacity of fats and other nutrients (Kashyap et al., 2013; Pucci & Batterham, 2019). A representation of the different procedures are shown in Figure 1.

Figure 1

Sleeve Gastrectomy, Roux-en-Y Gastric Bypass and the Mini Gastric Bypass



Note. Retrieved from (Beenakkers & Umcu, 2019).

1.2 Insufficient weight loss and weight regain after bariatric surgery

Bariatric surgery can provide sufficient weight loss, may improve or resolute obesity related comorbidities, improves quality of life and increases life expectancy (Amundsen et al., 2016; Campos et al., 2008; Devlin et al., 2016). Successful results of bariatric surgery are typically defined by 50% excessive weight loss and improvement or resolution of obesity-related diseases (Newman et al., 2021). However, not all patients experience optimal weight loss and the collateral health benefits of surgical treatment (E. M. Conceição et al., 2015). Insufficient weight loss is defined as an excess weight loss percentage (EWL%) of <50% within an 18-month time period post-surgery (El Ansari & Elhag, 2021). Several studies have shown that approximately 20% of bariatric patients show insufficient weight loss one year postoperatively (Amundsen et al., 2016; Higa et al., 2011; Lutfi et al., 2006). In addition, weight regain is reported in approximately 50% of bariatric patients within two years after surgery, with 15% of patients gaining ≥15% weight from nadir (Amundsen et al., 2016). Weight regain is defined as progressive weight regain that occurs after achieving an initial successful weight loss (defined as excessive weight loss percentage (EWL%) of >50%) (El Ansari & Elhag, 2021).

Patients must be able to make certain changes in lifestyle and behaviour in order for bariatric surgery to be successful and in order to achieve sufficient weight loss and to prevent weight regain. For example, it is important that patients learn how to deal with emotions, stressful situations, know how to improve healthy food choices and increase physical activity (Amundsen et al., 2016; Colles et al., 2008; Freire et al., 2012). Health care professionals offer patients assistance during pre- and postoperative care regarding positive changes in eating habits and aspects involved in maintaining weight loss, as weight regain or insufficient weight loss can lead to recurrence of comorbidities, depressive emotions and a decrease in quality of life (Berends & Nederlandse Vereniging voor Heelkunde, 2020; Freire et al., 2012).

1.3 Parameters influencing insufficient weight loss and weight regain

There are several parameters that contribute to insufficient weight loss and weight regain in post-bariatric patients. Nutritional non-adherence, physical inactivity after surgery, psychological factors, environmental factors and problematic eating behaviour are associated with insufficient weight loss and weight regain after bariatric surgery (Amundsen et al., 2016; Campos et al., 2008; El Ansari & Elhag, 2021; S. P. Goldstein et al., 2018; Melton et al., 2008; Sarwer et al., 2008).

First, nutritional non-adherence is associated with weight regain (Freire et al., 2012). Excessive consumption of snacks, sweets and fatty foods and the continuation of pre-surgical eating patterns are major causes of poor weight loss after bariatric surgery (El Ansari & Elhag, 2021). A study in bariatric practice concluded that 23% of the patients showed dietary non-adherence and a relapse in their pre-operative eating patterns, leading to unsuccessful weight loss and weight regain (Rusch & Andris, 2007). Second, physical inactivity contributes to weight regain after bariatric surgery (Campos et al., 2008). A cross-sectional study showed that of post-bariatric patients who reported no practice of physical activity, 68.9% showed weight regain compared with 45.4% of patients which were physically active (Freire et al., 2012). However, adherence to physical activity is an important predictive factor of weight maintenance according to research by Amundsen et al. (2016). Third, psychological factors can be associated with weight regain (El Ansari & Elhag, 2021). Psychological factors such as depressive symptoms occurring after bariatric surgery were found to be related to loss of control over eating, weight gain, binge eating disorder and concerns about patients' body image (Sousa et al., 2014). In addition, some patients show certain (negative) eating behaviours because they use food as a coping mechanism in order to deal with their emotions and mental health, which may hinder adherence to diet and exercise that are critical to maintaining weight loss in post-bariatric patients (Colles et al., 2008).

Fourth, eating behaviour is associated with weight regain and insufficient weight loss after surgery (Colles et al., 2008). A prospective study in bariatric patients reported that a postoperative

eating disorder is associated with less weight loss two or three years after bariatric surgery (Devlin et al., 2016). Possible weight regain following bariatric surgery has been associated with problematic eating behaviours such as binge eating disorder, grazing, craving and night eating syndrome (Amundsen et al., 2016; Livhits et al., 2011; Toussi et al., 2009). A growing body of research suggests that problematic eating behaviours are common in bariatric patients, which can significantly impact bariatric surgery outcomes. However, there are methodological inconsistencies in the literature that make such specific eating-related problems and their impact on treatment outcomes difficult to investigate (E. M. Conceição et al., 2015). For example, there are challenges in identifying eating behaviours and related symptoms in the bariatric population. The lack of consensus in terminology limits the ability to draw clear conclusions and treatment recommendations in both the pre- and postoperative phase of bariatric surgery (E. M. Conceição et al., 2015).

Lastly, environmental factors play a role in eating behaviour. In previous studies using Experience Sampling Methodology (ESM), contextual factors such as where eating occurs and the presence of others was investigated, which will be further discussed in Chapter 1.3.2 (Carels et al., 2001; Thomas, Doshi, et al., 2011). Environmental factors may explain the diversity in weight loss outcomes through behavioural effects; factors such as activity level, social context and location may play a role in whether or not weight loss is achieved (Thomas, Doshi, et al., 2011). For example, a previous study has shown that participation in support groups and receiving support from friends and family can be associated with better weight maintenance (Elfhag & Rössner, 2005).

1.3.1 The role of emotions in post-bariatric patients

Emotion cannot be defined as a single concept and is experienced personally by each individual. An important distinction can be made between positive and negative emotions. Examples of negative emotions are feelings of depression, anxiety, anger, sadness, frustration and shame. Positive emotions are feelings such as happiness, enthusiasm, cheerfulness and calmness (Cassin et al., 2013). Negative emotions are often accompanied by dissatisfaction of an individual's body in post-bariatric patients, which is associated with an increased food intake and problematic eating

behaviour (El Ansari & Elhag, 2021). These so-called 'emotional eaters' tend to overeat, putting themselves at risk of becoming overweight or obese (Bongers et al., 2013). The degree of weight loss is therefore often associated with either positive or negative thoughts about body image (Jumbe et al., 2017).

Canetti et al. (2009) defines emotional eating as "the tendency to eat in response to emotional distress and during stressful life situations." Approximately 38% of the bariatric population experiences emotional eating with women experiencing this problem more often than men (E. M. Conceição et al., 2015). However, knowledge about the relationship between emotional eating and weight outcomes is not coherent in the bariatric population. For example, research by Conceição et al. (2015) shows that some studies have shown no association between pre- and postoperative emotional eating and long-term weight loss, while other studies claim that weight changes may indeed be related to emotion in combination with eating behaviour (Fischer et al., 2007; Mathus-Vliegen, 2006). Furthermore, there are studies that show both positive and negative emotions in combination with food intake (Kenardy et al., 2003). Notably, evidence has also been found that lower food consumption can be linked to negative emotions instead of positive emotions (Bongers et al., 2013). Finally, changes in emotions lead to increased food intake, which in turn results in a positive or negative mood due to the consumption of food (Kenardy et al., 2003).

1.3.2 The role of contextual factors

There is a possible correlation between contextual factors and eating behaviour (Carels et al., 2001; Thomas, Doshi, et al., 2011). Contextual factors include the location, the activities that are being performed or social companionship. Previous studies have shown that a lack of social support from family and friends may lead to a more inactive lifestyle and negative feelings (Beltrán-Carrillo et al., 2019; Elfhag & Rössner, 2005). Also, relapses in diet tend to occur during certain activities, such as socializing, relaxing and working, which results in negative emotions such as anxiety or anger.
In addition, an ESM study found that the presence of others, activities, mood state and location may

be associated with feelings of temptation and dietary relapse (Carels et al., 2001). However, little emphasis has been placed in literature on whether contextual factors such as the presence of other individuals or location can predict weight loss in post-bariatric patients (S. P. Goldstein et al., 2018).

1.3.3 Problematic eating behaviour

Problematic eating behaviour includes binge eating, loss of control (LOC) eating, grazing, craving, night eating, and dietary relapse (Newman et al., 2021). Research shows that bariatric patients have higher rates of eating problems and eating disorders compared to the general population (Brode & Mitchell, 2019). Problematic eating behaviour can negatively affect the effectiveness of bariatric surgery due to insufficient consumption of healthy food (Devlin et al., 2016; Newman et al., 2021). Individuals dealing with problematic eating behaviour have an increased risk of insufficient weight loss postoperatively (Canetti et al., 2009; Martin-Fernandez et al., 2021). The text below explains the main forms of problematic eating behaviour that are most important in this study.

Loss of control (LOC) eating and binge eating disorder (BED) are forms of disordered eating behaviour, in which a very large amount of food is consumed in a short period of time with a loss of control over food intake (Brode & Mitchell, 2019; Meany et al., 2014; Newman et al., 2021). Due to the disproportionately large amounts of food intake, LOC eating is associated with weight problems such as insufficient weight loss and weight regain (White et al., 2010). LOC eating is common among bariatric patients with studies showing rates of 13% to 61% preoperatively and approximately 17% to 39% postoperatively (Sheets et al., n.d.). Despite the fact that there is little knowledge about emotions in combination with disordered eating behaviour in post-bariatric patients, the study by Wiedemann et al. (2018) indicates that LOC eating is associated with eating in response to fear, anger and happiness.

Another type of problematic eating behaviour is grazing. El Ansari et al. (2021) defines grazing as “repeated episodes of consumption of smaller quantities of food over a long period of

time, accompanied with feelings of loss of control." Literature indicates that grazing is often triggered by social or psychological conditions (McGrice & Don Paul, 2015). These include eating when an individual is stressed, emotional vulnerable, and in association with other activities such as watching television, computer work or engaging in social activities (McGrice & Don Paul, 2015). Research from Conceição et al. (2014) observed that the prevalence of grazing was 15% six months after bariatric surgery, with an increase in prevalence to 45.3% at two years postoperatively. The presence of grazing is associated with insufficient weight loss, weight regain and psychological distress postoperatively (Kofman et al., 2010; Pizato et al., 2017). The presence of other problematic eating behaviours such as LOC eating shows a threefold risk of expressing grazing (E. Conceição et al., 2014). Literature shows that there is an association between emotions (e.g., stress, anxiety and depression) and grazing (Goodpaster et al., 2016; Heriseanu et al., 2017). According to Goodpaster et al. (2016), the degree of agitation and negative thoughts is greater in this group than in individuals who show no grazing.

Next, craving is common among bariatric patients. According to Crowley et al. (2012), food cravings are "intense physiological drivers to eat or seek the ingestion of a specific food" and is present in the majority of post-bariatric patients. The percentage of craving is high; only 10% of post-bariatric patients experienced no cravings (E. M. Conceição et al., 2015; Guthrie et al., 2014). Feelings of craving occurred mainly at home when having company of others and later in the day (E. M. Conceição et al., 2015). Literature shows that on days with cravings, individuals were significantly more irritable, emotionally vulnerable, hungry and more anxious with a lower self-esteem compared with days when there was no craving reported (Guthrie et al., 2014). Furthermore, research has shown that food cravings may be associated with weight regain in individuals striving to achieve weight loss (E. M. Conceição et al., 2015). However, only few studies have investigated the relationship between food cravings and changes in eating behaviours after bariatric surgery (E. M. Conceição et al., 2015).

Lastly, dietary relapse should be discussed. Dietary relapse is defined as consuming foods or beverages that are likely to have a negative impact on weight, which may cause a relapse in an individual's diet. It can happen that individuals who have achieved weight loss fall back into their old unhealthy eating habits, which can eventually lead to weight gain. Various factors such as stress or pressure may play a role in dietary relapse (Carels et al., 2004). In addition, an ESM study from Carels et al. (2001) found that increased negative mood and involvement in specific activities (e.g., socializing or interpersonal conflicts) may lead to dietary relapse in overweight college students which are on a diet. Furthermore, stress appears to be a risk factor for dietary relapse, as stress can cause irregular eating patterns in overweight and obese individuals (Yau & Potenza, 2014).
In addition, research shows that individuals in stressful conditions ate significantly more than individuals in low-stress conditions, which may eventually lead to a relapse in diet (Royal & Kurtz, 2010). Despite the fact that several factors seem to have an effect on dietary relapse in different target groups, little is currently known about the possible association between emotions and dietary relapse in post-bariatric patients.

1.4 Experience Sampling Methodology (ESM)

Experience Sampling Methodology is a research method that monitors behaviour of individuals in their natural environment (Williams-Kerver et al., 2020). ESM is able to query various parameters such as emotion, contextual factors and eating behaviour in daily life (Boh et al., 2016; Verhagen et al., 2016). During an ESM study, individuals are asked to complete self-reports through an application at random hours of the day. The use of ESM is of added value because it collects real-time data which prevents participants from answering questions afterwards. Moreover, the received data can be considered reliable an detailed since participants answer questions on a mobile application several times a day for various days (Stone & Shiffman, 1994). This provides a vivid representation of an individual's feelings, thoughts and behaviours, as well as the events that may influence them. The use of ESM allows to investigate the natural variation that exists within

individuals; ESM is able to investigate to what extent the scores vary for a specific person over time (Palmier-claus et al., 2019). For example, measurements can be made to investigate fluctuations in emotions or feelings within or between days. Due to the reasons above, ESM is known for preventing bias as much as possible and ensures external validity (Palmier-claus et al., 2019; Verhagen et al., 2016).

Several studies have successfully applied ESM in which eating- and activity behaviour has been researched (Maugeri & Barchitta, 2019). For example, ESM research has been conducted into situational factors and food environment that influence eating behaviour in overweight and obese adolescents (Elliston et al., 2017). Findings by Elliston et al (2017) implied that both internal (i.e., affect) and external (i.e., presence of food, social context and observing others eating) factors increased the likelihood of eating. Besides, some studies have used ESM in obese patients waiting for bariatric surgery or to monitor eating behaviour of post-bariatric patients. For example, Mundi et al. (2015) used a smartphone-based ESM study to investigate recommended dietary behaviours and to promote healthy food choices in obese patients scheduled for bariatric surgery (Mundi et al., 2015). The study turned out successful and tended to promote behavioural changes and weight loss in patients. In addition, Thomas et al. (2011) used an event-contingent ESM to assess eating behaviours of patients undergoing bariatric surgery. Respondents complied well with the ESM study, which resulted in providing to be a useful tool for setting behaviour goals for postoperative monitoring and interventions (Thomas, Bond, et al., 2011). However, despite previous studies, ESM applications have not been used in post-bariatric settings when monitoring patients' emotions and contextual factors in relation to problematic eating behaviours. Considering the successfulness of ESM in previous studies, this method will most likely provide new insights that may contribute to the optimization of aftercare for bariatric patients.

In addition, limited research has been conducted on the effectiveness of technologies in postoperative care for bariatric patients (Versteegden et al., 2018). Research shows that eHealth has

been studied in terms of weight loss and weight loss maintenance (Sorgente et al., 2017) and appears to be useful in the treatment of obesity (Mundi et al., 2015). However, the value of eHealth in bariatric aftercare has not been studied. Due to the lack of research on ESM in bariatric surgery, there is little knowledge about the usability of an experience sampling platform (Sarwer et al., 2005). Therefore, it is of added value to investigate what patients think about the usability of an ESM application in the postoperative phase, and whether the use of such a tool can contribute to investigating the relationship between emotions and contextual factors in relation to problematic eating behaviour.

1.5 Objective and hypotheses

As mentioned above, several parameters play an important role in daily life and influence eating behaviour of bariatric patients. According to various studies, there is an inadequate focus on emotions and contextual factors in relation to problematic eating behaviour in patients who have undergone bariatric surgery (S. P. Goldstein et al., 2018; Newman et al., 2021; Sarwer et al., 2005; Williams-Kerver et al., 2020). In addition, existing studies provide conflicting findings on emotion, contextual factors and eating behaviour (Bongers et al., 2013; Goodpaster et al., 2016; Heriseanu et al., 2017; Kenardy et al., 2003). Due to variations in research methods that assess problematic eating behaviour and the differences in time periods regarding postoperative follow-up, it is unclear whether problematic eating behaviour is affected after bariatric surgery.

The current study is designed to better understand and analyse the relationship between emotion, contextual factors and problematic eating behaviour in post-bariatric patients. Since there is a shortage of ecological data concerning these factors, ESM was used as a research method to investigate various parameters in an individual's natural environment. The primary aim of this study is to investigate the association between emotion and contextual factors in relation to problematic eating behaviour in post-bariatric patients, using ESM. The secondary aim of this study is to gain insight into the usability of the ESM application from a patients' perspective. Via semi-structured

interviews, more depth can be obtained from the possible connections that arise from the data analysis and the usability of ESM can be questioned. In order to achieve the primary aim of this study, the following hypotheses were formulated:

Emotions

H: Emotions of anger are associated with loss of control (LOC) eating in post-bariatric patients.

H_2: Feelings of hunger are associated with craving in post-bariatric patients.

H_3: Feelings of stress are associated with grazing in post-bariatric patients.

H_4: Feelings of stress are associated with dietary relapse in post-bariatric patients.

Context

H_5: Being in company of others is associated with craving in post-bariatric patients.

H_6: Being at home is associated with grazing in post-bariatric patients.

2. Theoretical framework

2.1 Post-operative care after bariatric surgery

To minimize the risk of weight regain and insufficient weight loss, patients should be provided with appropriate follow-up care. During the entire healthcare process, patients are supported by a multidisciplinary team in order to realize lifestyle changes associated with lasting weight loss as much as possible (Berends & Nederlandse Vereniging voor Heelkunde, 2020; *Richtlijn Morbide Obesitas*, 2011). For example, various consultations are organized with obesity nurses,

psychologists and physiotherapists in order to receive the best possible aftercare with the aim of a healthier lifestyle for post-bariatric patients (Berends & Nederlandse Vereniging voor Heelkunde, 2020).

Several clinical reviews have emphasized the importance of adherence to follow-up care after bariatric surgery (Konings et al., 2020; Reiber et al., 2021). In general, patients who actively participate in follow-up achieve better outcomes, with a BMI in the long term being 10% lower than the patient group that does not participate properly in follow-up (Berends & Nederlandse Vereniging voor Heelkunde, 2020). However, a retrospective review by Higa et al. (2011) shows that compliance to follow-up remains a challenge for bariatric patients. Another retrospective review of gastric bypass patients showed that 65% of the patients missed at least one of their scheduled pre-surgery appointments, which remained high at 72% after surgery with increasing numbers of loss to follow-up over the years postoperatively (Reiber et al., 2021; Toussi et al., 2009). Poor adherence to follow-up treatment can be associated with insufficient weight loss, complications postoperatively and vitamin deficiencies which might lead to irreversible disorders (Reiber et al., 2021).

2.2 Bariatric treatment at ZGT

Hospital Group Twente (ZGT) is one of the bariatric centres in the Netherlands that specializes in bariatric surgery. Annually, an average of 12,000 patients undergo bariatric surgery in the Netherlands, of which approximately 590 surgeries are performed in ZGT (*Gewichtsverminderende Operaties - ZGT Almelo - Almelo*, n.d.). The hospital is classified as a top clinical hospital with a large care package for the region of Twente, consisting of one location in Almelo and one in Hengelo. ZGT has an important function in the region, with, in addition to various specializations, also supra-regional significance to its name, such as care of oncological nature and complex obesity and diabetes care (*Over ZGT*, n.d.).

Before patients are screened for a possible operation, a number of criteria must be met. First, an individual must have a BMI greater than 40kg/m² or a BMI between 35 and 40 kg/m² with

obesity-related comorbidities (i.e., diabetes, high blood pressure, sleep apnea or joint complaints). Second, an individual should be 18 years or older. Third, an individual must have adequate knowledge of healthy nutrition, exercise, and should have attempted other weight loss techniques. Finally, individuals must be willing to change their lifestyle after bariatric surgery (*Voorwaarden Voor Een Operatie in Het ZGT Obesitascentrum*, n.d.). If a patient meets the required conditions, a multidisciplinary screening procedure takes place. A surgeon, obesity nurse, dietician, psychologist and internist examine which type of surgery is most efficient for the patient (*Behandeling*, n.d.; *Het Multidisciplinaire Team van Het ZGT Obesitascentrum Staat Voor u Klaar*, n.d.). Next, the patient must attend a group meeting to gather information about the surgery and counseling programs. The patients also receive an invitation for a meeting with the surgeon and obesity nurse to discuss the procedure one more time. Finally, an appointment will be made with the anesthetist and the patient must participate in a mandatory group meeting of the dietician and the physiotherapist. On average, it takes four weeks after the mandatory group meeting before the operation takes place. Approximately three weeks after the bariatric procedure, new group meetings are organized for the postoperative recovery process (*Behandeling*, n.d.).

2.3 Post-operative care at ZGT

Several follow-up measures are taken after bariatric surgery in ZGT. The goal is to coach patients by providing advice about personal lifestyle adjustments and regularly follow-ups, since success in weight loss and maintenance depends on the degree of compliance with postoperative lifestyle recommendations (*Bariatrische Chirurgie*, n.d.). First, patients are called by the obesity nurse one week after surgery to schedule appointments for follow-up care and to ask how they feel. Second, the dietician is responsible for four mandatory group meetings in which patients are educated about calories, vitamin-intake and eating patterns (Vu, 2022). In addition, patients are informed about their limited gastric capacity after surgery. Nutritional recommendations are provided by dietitians about following a sufficient diet with planned meals or healthy snacks throughout the day. Foods that are relatively low in calories, but have volume and give a feeling of

satiety after consumption (e.g. various fruits and vegetables), are recommended in patients' eating schedules (Berends & Nederlandse Vereniging voor Heelkunde, 2020). Furthermore, the dietitian provides patients with useful information regarding eating patterns to let patients know what is needed to make conscious choices for lasting weight loss.

Third, the psychologist offers five optional group meetings about eating habits, mechanisms to cope with stress, reflecting on self-image and motivation. Fourth, the physiotherapist provides two group meetings to educate patients about physical activity and to train on fitness equipment in order to create awareness of their own capabilities (Vu, 2022). Lastly, the nurse specialist provides a yearly consult with the patient in order to check on the patient's wellbeing, their physical activity, eating behaviour and possible complications. During the consult, patients get informed about their vitamin and mineral results in order to address possible deficiencies. Since the absorption of calories and vitamins is limited due to the reduction of the stomach and diversion of the intestine, patients are provided with lifelong metabolic aftercare (Aills et al., 2008; Berends & Nederlandse Vereniging voor Heelkunde, 2020). This way, the goal of ZGT, namely realising targeted adjustments into individual's medical profile in order to achieve optimal treatment, can be achieved.

2.2 The eHealth Usability Benchmarking Instrument (HUBBI)

As mentioned before, there is little knowledge about the use of an experience sampling platform in post-bariatric patients (Sarwer et al., 2005). In order to clarify the role of an ESM application in scientific research, it is important to provide further information of the current state of affairs regarding eHealth and its usability in the healthcare sector.

In recent years, there has been a significant growth in the eHealth application market. In 2017, 3.7 billion downloads were made of mobile health applications, showing an increase of 16% from 2016. A staggering 325,000 health apps were available in most app stores mainly consisting of health, fitness and medical applications. In 2017 alone, no less than 78,000 apps were added to the most common app stores (Maramba et al., 2019). However, applying and implementing digital

solutions in the field of health problems is not an easy and simple matter. Several attempts have been made to increase digital health implementations, but these have been difficult to achieve and in some cases unsuccessful (Greenhalgh et al., 2017; van Limburg et al., 2011).

Usability is increasingly identified as a key ingredient of good practice when developing digital applications. Nowadays, usability can no longer be ignored as an essential key component when accepting digital health applications. Reason for this is that individuals who use health applications may or may not experience problems with using mobile applications due to their health conditions (Zapata et al., 2015). Consider, for example, the user-friendliness of mobile applications for older generations with health problems associated with ageing. Thus, it is necessary that health technologies are designed and implemented in a targeted manner in order to focus on the users and their preferences. Conducting usability evaluations of eHealth applications has tremendous value for the patients themselves, as better usability of health applications can lead to improved user-wellbeing and productivity, avoidance and reduction of stress, increased accessibility and reduced risk of harm, as stated in the International Standards Organization standard for Ergonomics of Human Computer Interaction (Maramba et al., 2019).

Generally, usability is described as 'the extent to which a system, product or service can be used by users to achieve specified goals with effectiveness, efficiency and satisfactions in a specified context of use' (Locality et al., 2009). The definition highlights how usability and the perception of this core factor can differ across products, contexts and even the targeted audience. This is mainly the case when a system is designed for the eHealth domain, since usability of eHealth differs from other domains in several areas (Broekhuis et al., 2019). The purpose of eHealth, for example, is often to monitor health and gain insight into an individual's personal situation in order to achieve the most optimal situation possible, instead of a game that is out for profit. Recently, more research has been conducted and awareness has risen about the term usability. As mentioned before, there are many factors that are important when using a health application. Factors such as complicated medical

jargon or functions that are considered too difficult for the older generation are examples of factors that can negatively influence the use of a eHealth system.

Nowadays, a few usability benchmarking tools are being used in eHealth services. However, these tools are often not classified as efficient, since the factors are often incomplete to test the usability of such technologies. They are often generalized or focus too much on specific eHealth factors (Broekhuis & van Velsen, 2022). The eHealth Usability Benchmarking Instrument (HUBBI) is a new and comprehensive usability benchmarking tool for the eHealth domain, developed by Broekhuis et al. (2020). The instrument assesses the usability of an application on eight domains and can quickly identify areas of the system that need to be optimized in terms of usability.
HUBBI provides insight into how various aspects of system usability are classified and assessed by individuals using an (eHealth-)application (Broekhuis & van Velsen, 2022). Therefore, the HUBBI can be of added value in current research to investigate the usability of an ESM application within the post-bariatric population.

Like other benchmarking questionnaires, the HUBBI uses a 5-point Likert scale. However, the HUBBI is the only benchmarking instrument that uses the full range of eHealth usability as described in the ontology for eHealth usability (Broekhuis et al., 2021). The ontology describes that 70% of the factors are general usability items that are relevant for all digital technologies, regardless whether or not they contain a specific domain. The remaining 30% includes eHealth specific items that are crucial for usability evaluation of eHealth applications (Broekhuis et al., 2021; Broekhuis & van Velsen, 2022). The eight categories of the HUBBI that classify the factors of usability of an eHealth system are Basic System Performance, Task-Technology Fit, Accessibility, Interface Design, Navigation & Structure, Information & Terminology, Guidance & Support, and Satisfaction. Thanks to these extensive categories, current research can investigate what participants think of the use of such an application, and whether there are areas for improvement. The different categories with corresponding factors can be found in Table 1.

Table 1

Categories and factors usability ontology for eHealth

Category	Usability factor	Type of usability factor
Basic System Performance	Technical performance	General
	General system interaction	General
Task-Technology Fit	Fit between system and context of use	General
	Fit between system and user	General
	Fit between system and health goals	eHealth-specific
Accessibility	Accommodation to perceptual limitations	eHealth-specific
	Accommodation to physical limitations	eHealth-specific
	Accommodation to cognitive limitations	eHealth-specific
Interface Design	Design clarity	General
	Symbols, icons and buttons	General
	Interface organization	General
	Readability of texts	General
Navigation & Structure	Navigation	General
	Structure	General
Information & Terminology	System information	General
	Health-related information	eHealth-specific
Guidance & Support	Error management	General
	Procedural system information	General
	Procedural health-related information	eHealth-specific
Satisfaction	Satisfaction with system	General
	Satisfaction with system's ability to support health goals	eHealth-specific

3. Methods

3.1 Setting and participants

This longitudinal research study took place at ZGT in Hengelo. Participants included patients who had undergone bariatric surgery in 2022 in ZGT. Exclusion criteria included (I) involvement in intervention program(s) or behavioural treatments after bariatric surgery that are outside the scope of the usual care after bariatric surgery within ZGT. Furthermore, participants were excluded who had (II) insufficient opportunity to follow the measurement protocol, e.g. in the case of terminal illness or cognitive impairment of uncontrolled psychiatric problems. In addition, (III) participants with insufficient command of the Dutch language in terms of speaking and writing were excluded and participants who (IV) did not own a mobile phone on which the ESM application had to be installed were not included in the study. Finally, individuals who were (V) unable to complete the questionnaires during the day (e.g. due to night shifts) were excluded from the study.

3.2 Design and Procedure

The research has been approved by the Ethical Review Committee of the University of Twente under request number 220802 and has been approved by the Advisory Committee for Local Feasibility of Scientific Research (ALU) of ZGT under request number ZGT20-48. Eligible patients were informed about the study in three various ways. First, patients were informed by the obesity nurse by means of a flyer with a QR-code (see Appendix A) 5 weeks postoperatively. Second, the study was emphasized by the surgeon during the telephone consultation 7 weeks postoperatively. Third, patients were recruited physically by the first author (C.v.d.B.) during postoperative group meetings with the dietitian in ZGT Hengelo. Lastly, for the semi-structured interviews, participants were recruited during the physical consultations of the dietitian in ZGT by the first author. If the patient consented to participate, they were asked to provide a telephone number to contact them after completion of the ESM study to set a date for the interview.

The flyer included a QR-code after which the participant was directed to a secured page on the ZGT website which contained specific information about the study. Patients interested in the ESM study were able to send an email to the coordinating researcher (E. K.), after which they were informed by phone by the first author and/or coordinating researcher about the purpose and content of the study. The interested patients were asked to install the ESM-application on their smartphone. If necessary, the patient was assisted in the installation of the ESM-application Ethica by the first author and/or coordinating researcher. In addition, three documents were sent to the patient for clarification: (I) a brief information brochure about the aim of the study and how to fill in the self-reported questionnaires (see Appendix B), (II) instructions to install the Ethica Data-app (see Appendix C) and (III) the test subject information (see Appendix D). Before the start of the study, patients had to give their consent for participation via the application Ethica Data. Participants did not have to make additional visits to the ZGT while participating in the study.

During the study, participants were asked to complete self-reports about emotions, contextual factors and eating behaviours six times a day for two weeks. The application gave a sound signal and/or message notification when the self-report had to be completed. The Ethic Data-app sends out questionnaires semi-random between 8.00 am and 9.30 pm, with a questionnaire being sent within a time block of 2.15 hours. Emphasis was placed on the importance that participants executed his or her normal activities as much as possible in order to conduct a real-time representation of daily life. Participants did not have to adjust their sleep rhythm to complete the questionnaires. When the participant received a notification from the app, the questionnaire had to be completed within 15 minutes. After five minutes, a notification was sent as a reminder. It was emphasized that participants should not think too long about the answers, since it was important to know how they felt at that particular moment. Finally, the participants were informed that they could win a gift voucher for participation.

3.3 Data collection

The data-collection was divided into two different parts. First, self-reported questionnaires were completed by participants on emotion, contextual factors and problematic eating behaviour. Second, semi-structured telephone interviews were conducted. By including the patient's perspective via interviews, more depth could be placed in the connections found from the data-analyses conducted from the Ethica Data-questionnaires and the usability of the application.

Age and gender were collected for each participant and whether there were any comorbidities such as Diabetes Mellitus (DM), hypertension, Obstructive Sleep Apnea Syndrome (OSAS), joint complaints and Gastroesophageal Reflux Disease (GERD). In addition, insight was gained in operative data by means of a general questionnaire, containing the type of surgery, operation date, and weight at time of surgery.

3.3.1 Self-reported questionnaires

The questions asked during the self-reports can be found in Appendix E. On day 1, participants were asked to complete a general questionnaire about their demographics (age and gender, possible comorbidities and type of surgery). On day 15, after completing the self-reported questionnaires for two weeks, participants were asked to complete the Dutch Eating Behaviour Questionnaire (DEBQ).

The self-reports consisted of 18 questions asked in Dutch, divided into various subscales (see Appendix E). The first question concerned the quality of sleep, which was asked once in the first questionnaire of the day using the Visual Analogue Scale (VAS) (0 = "Very bad", 10 = "Very good"). In question 2 through 11, emotions were examined by grading various statements about emotions using the VAS scale, ranging from 0 to 10. The following options were filled in by participants about emotions: angry/irritated, anxious/afraid, relaxed/calm, cheerful/happy, gloomy/sad, tense/stressed, boredom, disgust, fatigue and hunger. An example of a statement that asked for emotion was: "I feel relaxed/calm". In question 12 through 14, contextual factors were examined by

asking whether participants were in company of someone else, what they were doing, and where they were at that specific time of the day. For questions about contextual factors, participants could choose from a number of predefined answers. Examples of questions regarding contextual factors were: “Where am I?” or “What am I doing?”. Finally, questions 15 through 18 questioned participants’ eating behaviour. Craving was surveyed using the VAS scale (0 = “No desire”, 10 = “Large desire”) with the question: “Have you had a craving for a specific food in the past 30 minutes? And how strong was this desire?”. Dietary relapse, LOC eating and grazing were surveyed using a categorical variable (yes/no). Examples of these questions were: “Have you consumed unusually large amounts of unhealthy food in the last 60 minutes?” and “Have you unplanned and repeatedly eaten small amounts of food outside of the scheduled meals and snacks in the last 60 minutes?”.

3.3.2 Semi-structured interviews

In order to gain more clarity on the possible connections found in the ESM study and the usability of the application Ethica, semi-structured telephone interviews were held to clarify and map the patient’s perspective. Five short telephone interviews were held in Dutch and were conducted with a maximum duration of 20 minutes. Permission to make audio-recordings were asked beforehand and the interviews were transcribed and anonymized to ensure privacy.
The questions for the semi-structured interviews can be found in Appendix F.

The interview schedule was based on the HUBBI, which is a new and comprehensive usability benchmarking tool for the eHealth domain. The HUBBI gave the opportunity to ask open, in-depth questions based on given answers from participants to clarify their answers from the closed questions of the self-reports. The main structure of the interview scheme is based on the formulated hypotheses and categories of the HUBBI. To clarify the findings of the ESM study, participants were asked a maximum of two questions per hypothesis. For example, the participant was asked whether they agreed with the result of the data analysis in terms of emotions and contextual factors in combination with eating behaviours. In addition, several questions were asked about how the

participants experienced the use of the application. These questions concerned topics about the amount of questions and the user-friendliness of the app. Examples of questions were: “What did you think of the amount of questionnaires?” and “What would you think if we used the application in the aftercare process of bariatric surgery?”.

3.4 Ethica Data

Ethica Data is a specific questionnaire application that is frequently used for ESM data. Participants who participated in the study were given an unique access code. Ethica Data stores the collected data in an online environment in Canada, where similar privacy guidelines apply to those in the European Union. The collected data is stored in a database of Ethica Data to prevent third parties from gaining access to personal data of the respondents. This is achieved by using two separate databases located on different servers. The registration data of the participant (name and email) are stored on a different server than the data obtained from the ESM study (answers received from the questionnaires). Several Ethica Data employees have access to participant registration information to provide technical support when needed. However, they do not have access to the obtained study data. Only researchers have access to the study data and can analyse the data.
A visual representation of the questions in Ethica can be found in Appendix G.

3.5 Statistical Analysis

The data obtained from the application Ethica was first exported in a CSV format and imported into Microsoft Excel version 2203 to allow a short pre-screening in order to gain oversight in the existing data. Second, IBM SPSS Statistics 28 was used for the data analyses (*Downloading IBM SPSS Statistics 28.0*, n.d.). Descriptive statistics for age, weight, height, and BMI were carried out to summarise demographic information about the respondents. Moreover, it was investigated which cut-off score should be used for the response rate of this ESM study. The cut-off score for the response rate was set a 33.3% since the average response rate within ESM momentary assessments evolves around completing one third of the questions (Inez Myin-Germeys & Kuppens, 2022).

Due to ESM's longitudinal and multi-level structured data, Linear Mixed Models (LMMs) were used. LMMs are useful when it comes to appropriately handling repeated measures where observations are clustered within individuals. Another advantage of LMM is that it has the property of paying attention to missing values by estimating the missing data accordingly (Kreft & de Leeuw, 2011; Molenberghs & Verbeke, 2000). All LMMs were performed using a first-order autoregressive (AR1), since this structure predicts that the correlations found between measurements decrease exponentially over time (H. Goldstein et al., 1994).

For all hypotheses, the measurement was set as a repeated variable, the repeated covariance type was set on AR(1) and the dependent variable included the type of problematic eating behaviour. Different types of emotions were set as fixed covariates (fixed variables) and the place or activity were set as fixed factors (categorical variable). To test the first hypotheses, concerning the possible association between anger and LOC eating, a LMM was performed using LOC eating as a dependent variable and the emotion anger as a fixed covariate. ID served as a random factor and subject variable to account for variation over time and by participant. These settings were applied for the first four hypotheses with emotions as independent variables. For the last two hypotheses, concerning the possible correlations between specific places or activities and some form of problematic eating behaviour, a LMM was performed using problematic eating behaviour as a dependent variable and the place or activity as fixed factors. Again, ID served as a random factor and subject variable to account for variation over time. A p-value of $<.05$ was considered significant.

Finally, the transcripts of the interviews were analysed using a qualitative data analysis software named ATLAS.ti. The transcripts were divided into sections based on the questions that were asked; questions about the correlations found in the hypotheses and questions about the usability of the application Ethica. The broken sections were analysed through deductive coding, in which codes were created based on the content of the data (Soratto et al., 2020).

4. Results

4.1 Demographics

A total of 179 respondents were approached in this study. Of these, 40 respondents agreed to participate in present ESM study. Eventually, 25 respondents downloaded the Ethica application with the associated questionnaires. One respondent was removed since no questionnaires were filled in. Two respondents completed several ESM questionnaires, but did not fill in the baseline data and were therefore removed from the study. Four respondents did fill in the baseline data, but were excluded since they did not reach the requirement of a 33.3% response rate.

In total, 18 respondents were included in the data analysis of which 13 respondents were female (72.2%) and five were male (27.8%). The age span was between 27 and 65 years old with a mean age of 48.7 years old (*SD*=11.78). During the study, a total of 1,512 questionnaires were sent to the 18 respondents by the application Ethica. Given the number of respondents (*N*=18) and the total number of questionnaires during the 14-day period (84 questionnaires per respondent), a total of 1,512 questionnaires should have been collected. However, Ethica contained a bug in the application which led to two missing questionnaires for one respondent. As a result, 82 instead of 84 questionnaires were collected for this respondent. This resulted in a total of 1,510 questionnaires.

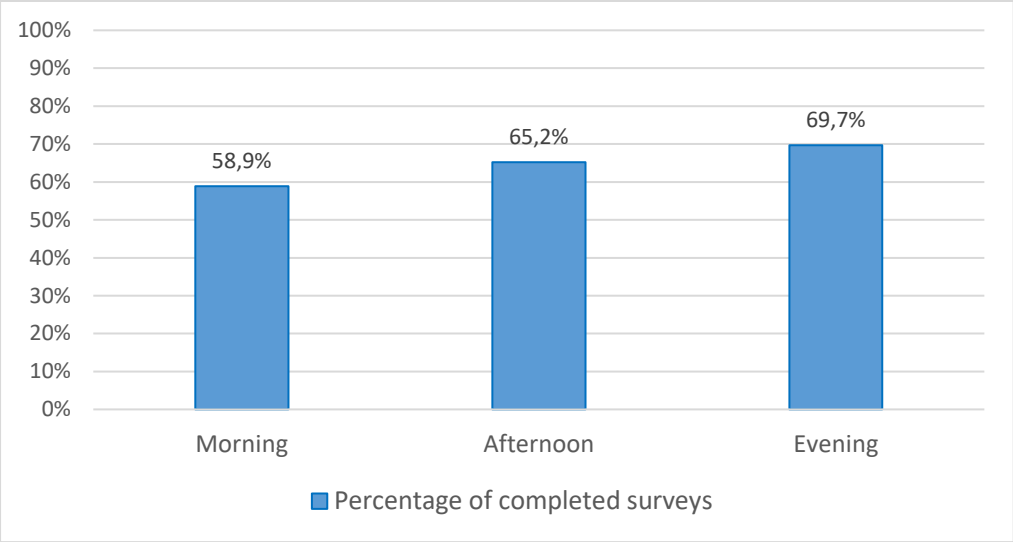
4.2 Compliance ESM questionnaires

The total percentage of completed questionnaires compared to the total number of notifications received by the respondents during the 14-day ESM period was calculated. For the 18 respondents included, there were 507 out of 1,510 expired data points (33.6%), meaning a total of 1,003 questionnaires were completed. Overall, 66.4% of the questionnaires were completed in Ethica, with compliance varying between 35% and 89% for the 18 respondents included (*SD*=0.15). The average time to complete a questionnaire (seconds from response to completion time) was 64.9 seconds. Figure 2 shows the response rates per time of day during the 14-day ESM study.
The respondents received one or two questionnaires in the morning (8.00 am up to 12.00 pm), three

or four questionnaires in the afternoon (12.00 pm up to 6.00 pm) and one or two questionnaires in the evening (6.00 pm up to 9.30 pm). On average, the response rate was a few percentages higher in the evening than in the morning and afternoon.

Figure 2

Response rates per time of day during the 14-day ESM study



4.3 Problematic eating behaviour

The frequencies and percentages of the different problematic eating behaviours can be found in Table 2. In total, 65 problematic eating behaviours were reported during the two weeks of completing the questionnaires. Almost all of the 1,003 questionnaires were filled in completely. Only for a small number, some answers concerning questions about problematic eating behaviour were missing (see Table 2). LOC eating showed the lowest frequency as type of problematic eating behaviour among respondents (7 out of 1,003 questionnaires (0.7%)). Grazing is the second lowest form of problematic eating behaviour in current study (13 out of 1,003 questionnaires (1.3%)). The most common form of problematic eating behaviour among respondents who participated in this 14-day ESM study is dietary relapse (45 out of 1,003 questionnaires (4.5%)). Lastly, low percentages of craving occurred in current study which were measured on a VAS scale from 0 through 10.

For example, a score of 0 was indicated 643 times (out of 1,003), indicating that craving was zero in 64.1% of the questionnaires during the study. None of the respondents entered a score of 10.

Table 2

Frequencies and percentages problematic eating behaviour

Problematic eating behaviour		Frequency	Percent
LOC eating	Yes	7	0.7
	No	983	98.0
	Missing answer	13	1.3
	Total	1,003	100
Dietary relapse	Yes	45	4.5
	No	947	94.4
	Missing answer	11	1.1
	Total	1,003	100
Grazing	Yes	13	1.3
	No	974	97.1
	Missing answer	16	1.6
	Total	1,003	100
Craving	0	643	64.1
	1	228	22.7
	2	54	5.4
	3	24	2.4
	4	11	1.1
	5	12	1.2
	6	10	1.0
	7	4	0.4
	8	7	0.7
	9	1	0.1
	10	0	0
	Missing answer	9	0.9
	Total	1,003	100

Note. LOC eating: loss of control eating

4.4 Overall emotions and activities

The mean scores and standard deviations of the different emotions can be found in Table 3. In general, respondents were in a positive mood during the surveys, with emotions such as excitement and calmness predominating. The emotions anger and anxiety occurred least among respondents. The percentages of different places and activities can be found in Figure 3 and 4.

In terms of place, it can be seen that, during most times, individuals were at home (57.0%) when

they filled in the ESM questionnaire. In terms of activity, individuals were engaged in some sort of relaxation (17.0%) or at work (14.9%) while completing the questionnaires.

Table 3

Mean and standard deviation (SD) of the different emotions

Emotions	Mean	SD
Anger	0.49	0.89
Anxiety	0.41	0.76
Calmness	6.67	2.35
Excitement	6.69	2.06
Sadness	0.64	1.18
Stress	0.88	1.44
Boredom	0.66	1.26
Disgust	1.41	2.08
Fatigue	3.70	2.77
Hunger	1.15	1.85

Figure 3

Percentage of different activities

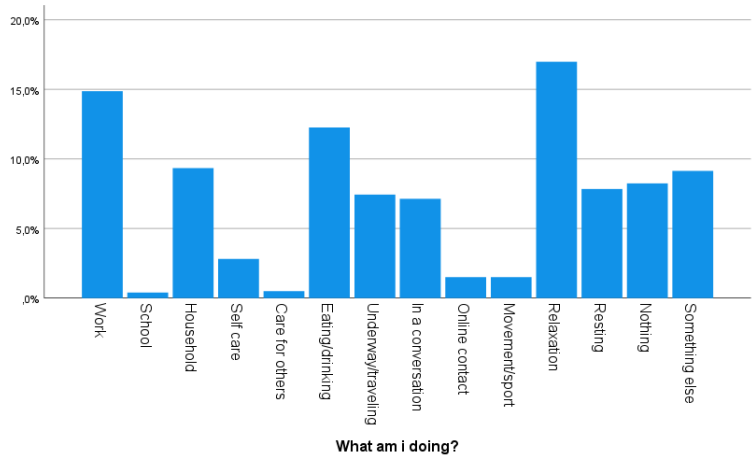
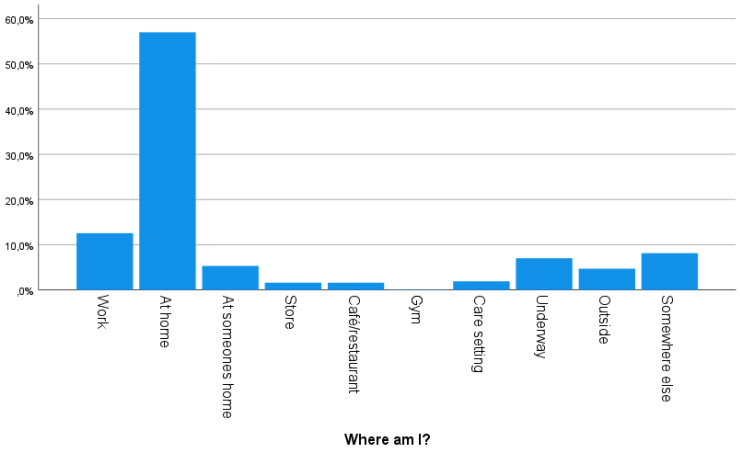


Figure 4

Percentage of different places



4.5 Hypotheses

The most important findings per hypothesis can be found in Table 4. A significant effect was found for two out of six hypotheses. For the first hypothesis, emotions of anger showed no significant effect (*B*=.001*, p*=.789) on LOC eating. For the second hypothesis, feelings of hunger showed a significant effect on craving (*B*=.093, *p*<.001). Regarding the third hypothesis, the association between stress and grazing was examined. Results of the ESM study show a significant effect between stress and grazing in post-bariatric patients (*B*=-.008, *p*=.004). For the fourth hypothesis, feelings of stress showed no significant effect on dietary relapse (*B*=.005, *p*=.308). For the fifth hypothesis, the association between whether an individual is in company of others and craving showed no association. Being alone (*B*=-.056, *p*=.549) or in company of others showed no significant effect on craving as the dependent variable. Lastly, for the sixth hypothesis, the association between being at home and grazing was examined. For place as the independent variable, no association has been found. Individuals that are at home show no significant effect (*B*=.022, *p*=.146) on grazing as the dependent variable.

Table 4

Emotions, place and activity as predictors of problematic eating behaviour in post-bariatric patients

Dependent variable	Parameter	B (*Estimate)*	Standard Error (*SE)*	df	t	Sig	CI 95% Lower Bound	CI 95% Upper Bound
LOC eating	Anger	.001	.003	235.591	.267	.789	-.006	.008
Craving	Hunger	.093	.023	979.246	3.975	<.001	.047	.138
Grazing	Stress	-.008	.003	184.734	-2.925	.004	-.013	-.003
Dietary relapse	Stress	.005	.005	529.114	1.020	.308	-.005	.016
Craving	Alone	-.056	.093	968.178	-.599	.549	-.238	.127
Grazing	At home	.022	.015	334.957	1.459	.146	-.008	.051

Note: df Degrees of freedom *CI* Confidence interval of unstandardised estimations

4.6 Semi-structured interviews

A total of 5 respondents participated in the semi-structured interviews, which were aged between 28 and 65 years old (*SD*=15.18). The respondents consisted of four females and one male. The respondent characteristics can be found in Table 5.

Table 5

Respondent characteristics (N=5)

Respondent	Gender	Age	Compliance ESM study
1	Female	57	89%
2	Female	36	51%
3	Female	28	73%
4	Female	65	82%
5	Male	51	63%

Hypotheses

The transcripts of the semi-structured interviews could be subdivided and coded into the following sections for the hypotheses: emotional thoughts, LOC eating, craving, grazing, dietary relapse, eating behaviour, lifestyle adjustments, temptation/desire, time schedule (food-intake), food portions, activities, and place/surroundings. The main findings of the semi-structured interviews will be explained in more detail. The number of the respondents who did or did not experience some form of problematic eating behaviour and a summary of the answers given can be found in Table 6.

Table 6

Summary of answers and explanations hypotheses (N=5)

Hypotheses	Answer respondents	Explanation
H_1: *Anger is associated with LOC eating*	No (*N*=5)	Experienced little anger and no LOC eating.

H_2: *Hunger is associated with craving*	Yes (*N*=2)	Desire for specific foods such as sweets or fruit (easy to digest).
H_3: *Stress is associated with grazing*	No (*N*=5)	Little experiences of stress (no work during the first 3-4 weeks, or not being able to consume much food while being stressed).
H_4: *Stress is associated with dietary relapse*	No (*N*=5)	Experiencing little stress during the post-bariatric phase.
H_5: *Being in company of others is associated with craving*	No (*N*=5)	Tendency to join others, but redeemed themselves due to the fixed meal schedules per day.
H_6: *Being at home is associated with grazing*	No (*N*=5)	Not experiencing grazing during the 14-day ESM study (but was experienced in the period after the ESM study).

H_1: Emotions of anger are associated with loss of control (LOC) eating in post-bariatric patients.

According to the semi-structured interviews, none of the respondents experienced emotions of anger in combination with LOC eating. The respondents indicated that they generally had little experience with anger, and if so, it had no influence on their eating behaviour. Respondent 1 mentioned: "I don't think I'm bothered by anger anyway, so not even when I eat something." The respondent explained that the emotions she experienced in the first months after surgery gave her a positive flow. Because she felt well during the postoperative period and during the 14-day ESM study, there were no feelings of anger or LOC eating.

H_2: Feelings of hunger are associated with craving in post-bariatric patients.

Two out of the five respondents of the semi-structured interviews experienced feelings of hunger in association with craving. In particular, there was a desire for a specific type of food such as sugar-containing products and fruit. One of the respondents mentioned: "I mainly needed fruit and some lighter food, but not bad food, so to speak". According to the respondents, the reason was that they perceived sweet foods or drinks as easier supplements to digest than, for example, savoury foods. Finally, another respondent indicated that she did not particularly had a desire for unhealthy food, but mainly for easily digestible food which she did not consider to be craving behaviour.

H_3: Feelings of stress are associated with grazing in post-bariatric patients & H_4: Feelings of stress are associated with dietary relapse in post-bariatric patients.

None of the interviewed respondents experienced stress in association with grazing. Respondent 1 explained that she had been out of action for three to four weeks (including work) after bariatric surgery, which contributed to little experience of stress. The same respondent indicated that during that period, she consciously tried to shut herself off from stressful situations or questions by others. Respondent 3 mentioned that when she experiences feelings of stress, she has less desire for food and is saturated faster which she thought resulted in no feelings of grazing during participation in the ESM study. Regarding the association between stress and dietary relapse, none of the respondents of the semi-structured interviews reported this feeling. One respondent indicated: "I think I did experience dietary relapse, but not in that period of filling in the questionnaires. Sometimes you try to look around; do I get a dumping or not. But I didn't have that during that period, the same applied in terms of stress."

H_5: Being in company of others is associated with craving in post-bariatric patients.

None of the interviewed respondents has experienced feelings of craving while being in company of others. However, some respondents did have a tendency to join family or friends for dinner when they saw them eating. Nonetheless, this was often experienced as a pleasant moment, with respondents indicating that they are used to grabbing food when the other person does too. However, it was easier for the respondents not to go along with this desire since they indicated that they knew well what they should eat in a day. Moreover, respondent 2 indicated that they were very careful about consuming food in company of others. During birthdays or other social occasions, she indicated that she still experienced the psychological effect that she had the desire to go for the old and large portions which were considered too much. As a result, the realization came that smaller portions were enough.

H_6: Being at home is associated with grazing in post-bariatric patients.

None of the respondents of the semi-structured interviews experienced grazing as a form of problematic eating behaviour when they were at home. The same applied for when they were elsewhere. One respondent did indicate that, in recent weeks, she had the tendency to eat small amounts of food (e.g. gingerbread cookies) outside of the planned meals. However, she clearly indicated that this was seen as a snack-moment, which did not occur during the 14-day ESM study. Another respondent mentioned: "I adjusted everything at home and everyone participates. I also bought smaller plates." This respondent made new purchases in order to precisely adjust the amount of food that can be consumed per meal. According to the respondent, this solution contributed to the fact that the respondent did not experience any form of grazing as type of problematic eating behaviour.

Usability application Ethica

During the semi-structured interviews, the following categories with associated factors have been used to investigate the usability of the ESM application: Basic System Performance, Task-Technology Fit, Information & Terminology, Guidance & Support, and Satisfaction. The categories with the associated questions and corresponding answers will be explained in more detail.
A summary of the given answers can be found in Table 7.

Table 7

Respondents' opinion on the usability of the application Ethica (N=5)

Categories HUBBI	Questions	Keywords
Basic System Performance	Overall opinion Ethica	✓ Easy and pleasant to use ✓ More consciousness about their eating behaviour

Task-Technology Fit	Number of questions, questionnaires, and notifications	✓ Good amount of questions ✓ High completion speed ✓ Repetitive questions resulted sometimes in answering on autopilot
	Use of application in daily life and causes for incomplete/expired questionnaires	✓ Work (e.g. irregular shifts) ✓ Underway (e.g. travel time) ✓ Only 15 minutes response time
	Use of application in the aftercare process of bariatric surgery	✓ Apply in pre- and postoperative phase ✓ Awareness of actions and emotions
Information & Terminology	Comprehensibility of the questions	✓ Understandable ✓ Helps in recovery process ✓ More consciousness while answering
Guidance & Support	Not being able to see results after 14-day ESM period	✓ Well informed about research ✓ Mainly for scientific research ✓ No added value to have access to results ✓ No insight might be better
Satisfaction	Improvement of the application content Ethica	✓ More response time to complete questionnaire ✓ Questions in different order ✓ New invitation after one year postoperatively ✓ Digital monitoring by healthcare professionals

Basic System Performance

In this category, respondents were asked about their overall opinion about the use of the application Ethica. All five respondents indicated that the app was easy and pleasant to use. This made it possible for the respondents to get through the questions fast. However, two of the five respondents felt that the questionnaires sometimes came in after each other quite quickly. As a result, they missed the questionnaire a few times. Three respondents (1,2 and 3) indicated that they started eating more consciously because they received the questions at random times and thought at that specific moment: “What did I actually eat and drink and how do I feel about that?”.

Task-Technology Fit

All in all, the questions were perceived as excellent. According to the respondents, the number of questions was good since they knew which questions would come at a certain point. Therefore, they could easily go through the questionnaires which resulted in a quick completion time. However, two respondents indicated that they found it difficult that the same repetitive questions were being asked. With regard to the number of notifications sent by the app, the respondents did not mention any problems. The respondents indicated that the time between the notifications was not really tracked by them. However, respondent 1 thought: "I already filled this in 1.5 to 2 hours ago. In that time, not much has changed in terms of my answers to those questions." In addition, respondent 3 indicated that she had the idea that she was completing the questions on autopilot after two weeks since she knew which questions would come and in what order.

Respondent 1 indicated that she had given some thought to the question of what she would think if the application would be used in the aftercare process. The respondent thought that the application could be of added value for an individual who is very bothered by emotional eating or other types of problematic eating behaviour. She suggested that the questionnaires could also be completed by the patients before bariatric surgery, so that researchers could examine how an individual experiences his or her emotions in combination with a certain type of eating behaviour. Interestingly, she also referred to use the application Ethica, for example, right after surgery and one year after the operation in order to compare the results of different timeframes. Moreover, this suggestion is in line with respondent 3, which indicated that she would probably give different answers to the questions in six months compared to one month after surgery since she knows better what her body is asking for compared to a couple of months ago. Respondent 5 was the only respondent who doubted whether the app has added value in the aftercare process. This respondent mentioned he did not experience the app as much of an advantage in use.

Respondent 3 and 4 indicated that the questionnaires can help an individual to become more aware of his or her actions: “Is what I'm doing right?”. And in order to reflect on emotions: “What exactly is happening?”. The phenomenon ‘emotional eating’ was mentioned as well. This event is explained by the dietitian, but by also having the questionnaire completed before the operation, the psychological aspect is fully included, according to respondent 2. As a result, more awareness can be created. However, the respondent mentioned that the questions can also be experienced as confrontational. Finally, respondent 4 indicated that, fewer questions should be sent per day if the application will be used in the aftercare process of bariatric surgery since she thought individuals wouldn’t like that many questions.

Finally, the main reason why not all questionnaires could be completed was that the respondents were either at work or on the road. For example, respondent 3 indicated: “I was at work at the time. I have irregular shifts because I also work in healthcare, so I couldn’t always complete the questionnaire properly.” Another respondent indicated that she had a lot of travel time for work (at least 30 minutes). As a result, the questionnaire could no longer be completed since the message was noticed after 15 minutes. Respondent 5 stated that due to the short completion time, the questionnaires could not always be completed in time since the notifications sometimes could simply not be heard due to the noise around him.

Information & Terminology

In this category, respondents were asked what they thought of the questions asked. According to the respondents, the questions asked were fine. Furthermore, one respondent indicated that the questions did make her think about her actions and helped her in her recovery process. She indicated that she knew well where her triggers were in terms of nutrition, but since she had to read the questions again and think about her emotions, those thoughts came in more consciously. Normally, these thoughts are easier to fade according to her. Moreover, respondent 1

mentioned: “The questions matched with what you could expect. You had already explained it a bit before that time at the dietitian’s group meeting.”

Guidance & Support

For the category Guidance and Support, respondents were asked what they thought about the fact that they had no insight into their own answers after the 14-day ESM period. During the telephone interviews, several respondents (1,2 and 4) indicated that they had been well informed about the aim of the study and the use of the Ethica app during the dietitian's group meeting in ZGT prior to the two-week survey. As a result, the start of the study went smoothly according to them and they managed to help themselves in terms of registering for the study and installing the app.

The respondents were not bothered that they had no insight into their own answers. They were aware of the fact that it was a scientific study and that the results are therefore mainly important for the researchers. One of the respondents even indicated that it might be better if you could not have insight into the answers, since you might get the idea that you should fill in something else next time when the answer was considered ‘bad’. The other four respondents indicated that they probably would not do much with the results. However, one respondent thought: “What am I doing now and what did I think of this food?”. Which made the respondent more aware of her actions and emotions. Yet another respondent thought that some kind of feedback might took place during the interview. She wondered out of curiosity what other patients had filled in: “Are they on the same page as me? And what exactly happens with the information found?”.

Satisfaction

Finally, the respondents were asked about what they thought could be improved with regard to the content of the application. First, the respondents indicated that they do not immediately have points for improvement for the application Ethica. However, they wondered

whether changes could be made in terms of how long a questionnaire could remain open. Based on this suggestion, it was already filled in by the respondents themselves that this was more of a technical issue.

Another respondent mentioned that the questions should occasionally be put in a different order. This way, the respondent has to think carefully about which question should be answered every time a questionnaire has to be filled in. In addition, the respondent mentioned that it would be interesting if the app would give a notification with the following note: ''In an *x* number of months you will receive another invitation to complete this questionnaire again.'' The respondents mentioned that, compared to six months ago (prior to surgery) when they did not had to complete the questionnaires, they now think more consciously about the choices they made with regard to nutrition.

Furthermore, it was also suggested to add a question in the app. For example, one respondent mentioned the question: “What do all these questions do to you? And will this result in positive or negative answers?” If this results in negative answers, a health professional may be able to take action by calling in a dietician or psychologist. This way, a health professional can remotely assess whether it is necessary to have contact with a patient, based on his or her answers to the questions. The respondent indicated that this would have been a plus for her, because she does not have to visit every consult physically. However, she emphasized that it remains important to see patients face-to-face. Attentiveness could therefore be properly monitored through a technological innovation, but when problems arise, she believes it is certainly important that personal contact should have the upper hand with this specific patient.

5. Discussion

The current study employed ESM and the application Ethica to examine emotions and contextual factors in relation to problematic eating behaviour in post-bariatric patients. In addition, insight was obtained into the usability of Ethica from a patients' perspective by conducting semi-structured interviews. The present research observed that hunger has a significant effect on craving and that stress has a significant effect on grazing. Moreover, results from the semi-structured interviews showed that this innovative technology can be of added value for bariatric patients in the post- and even preoperative phase. This chapter provides a discussion of the main findings, strengths and limitations of this research, future research directions and implications.

5.1 Main findings

The present study found associations between problematic eating behaviour when experiencing certain emotions. First, this study confirms that there is an association between hunger and craving in post-bariatric patients. The semi-structured interviews confirm this association, since several respondents stated that they had a desire for particular foods such as sweets and fruit, which was associated with feelings of hunger during the period they had to fill in self-reports in Ethica. However, research by Conceição et al. (2015) does not clearly show that craving was caused by emotions such as hunger in post-bariatric patients. In addition, another study found that individuals were significantly more irritable, anxious and hungry on days with craving compared to days when no craving was reported (Guthrie et al., 2014). Therefore, the findings from literature cannot be fully linked to the findings of present study, since the emotion hunger was associated with craving as a type of problematic eating behaviour, while the findings of Guthrie et al. (2014) examined it the other way around where craving leads to certain emotions.

Second, present study confirms that there is an association between stress and grazing in post-bariatric patients. This is in line with previous research that suggests that individuals exhibiting stress show more grazing (Heriseanu et al., 2017). Other studies also show that stress and grazing

work the other way around; they report that individuals who exhibit grazing experience more stress and depressive symptoms as a result (Goodpaster et al., 2016; Mack et al., 2016). Moreover, poorer postsurgical weight loss and increased stress are the result when grazing is experienced in both the pre- and postoperative phase (Colles et al., 2008). Despite the association found, it is noticeable that none of the interviewed respondents indicated that they had experienced stress in association with grazing during the current study. An explanation is that the interviewees indicated that they experienced little stress during the 14-day ESM period. One respondent also indicated that when she experienced stress, she had less desire for food and was saturated faster, leading to no experience of grazing.

With regard to the emotion anger, no association with LOC eating has been found in current study, while previous research has shown a significant association between anger and the expression of LOC eating in post-bariatric patients (Wiedemann et al., 2018). A possible explanation for the lack of the association between anger and LOC eating is that LOC eating barely occurred in the current ESM study (0.7%) and that little anger was visible among the respondents (*M*=0.49, *SD*=0.89). This was also confirmed by the interviews. The respondents had little experience with anger and none of them showed emotions of anger in combination with LOC eating during the 14-day ESM study. Next, no association was found between stress and dietary relapse in present study, which was confirmed by the semi-structured interviews since none of the respondents experienced this association. However, a study that conducted semi-structured interviews indicated that stress can be associated with dietary relapse in post-bariatric patients (Tolvanen et al., 2022). In previous studies of dietary relapse, respondents reported that they experienced weight regain as a result of dietary relapse with loss of control and focus. In addition, feelings of hopelessness, stress and frustration were associated with dietary relapse (Groven & Glenn, 2016; Tolvanen et al., 2022). The absence of this association in current study is therefore not consistent with literature. A reason for the lack of this association might be linked to the fact that dietary relapse (4.5%) and stress (*M*=0.88, *SD*=1.44) occurred to a small extent among the respondents in this ESM study. Lastly, no

associations have been found between contextual factors and problematic eating behaviours in current study. Both the questionnaires and the semi-structured interviews show the absence of this association. This is not in line with literature, since research from Guthrie et al. (2014) stated that craving occurs when individuals are at home and in company of others.

Next, another important finding is that problematic eating behaviour hardly occurred in this ESM study. The current study shows that LOC eating occurred with an average of 0.4 times per individual. Furthermore, dietary relapse occurred with an average of 2.5 times per individual and grazing occurred 0.7 times per individual during the 14-day ESM study. There are several possible explanations for the low findings of problematic eating behaviour in post-bariatric patients.
One explanation is that problematic eating behaviour was more common than the respondents of the ESM study indicated. It may be possible that relatively many questionnaires were not completed at times when respondents did show problematic eating behaviour. Previous ESM studies show that the average compliance of respondents was between 76% and 94% with a minimum duration of three weeks (Forman, Goldstein, et al., n.d.; Forman, Schumacher, et al., n.d.; Shiffman et al., 2008; Stone & Shiffman, 1994). On average, these response rates are 10% to 30% higher than the compliance resulting from present study (66.4%). The lower compliance in current study could be caused by the fact that the target group found it too burdensome to answer questions about eating behaviours and emotions post-operatively, given the longitudinal nature of typical ESM studies (Van Berkel et al., 2018). The semi-structured interviews confirm that several respondents found it difficult to complete all questionnaires due to the high number of self-reports. In literature, this is described as response fatigue; both the number and the quality of the number from respondents decreases as the survey runs longer due to a reduced interest in contributing to the study (Fuller-Tyszkiewicz et al., 2013; Van Berkel et al., 2018). For example, respondents receive notifications and have to complete questionnaires while being busy with their daily activities, which can cause frustration and reduced interest (Palmier-claus et al., 2019).

Another explanation is that problematic eating behaviour indeed hardly occurred in the bariatric patients during the 14-day ESM study. A first reason could be that respondents experienced predominantly positive emotions during this ESM study (see Table 3). In the current ESM study and the conducted interviews, negative emotions such as anger and stress were not that common. This is in line with the literature, which states that bariatric surgery is associated with positive changes in psychological health and significant decrease in depression and anxiety (Kubik et al., 2013). Due to weight loss, patients concluded that they feel more energized, develop a positive self-image and therefore experience improvement in quality of life after bariatric surgery (Van Hout et al., 2006). A second reason could be that information about emotions and contextual factors in relation to problematic eating behaviour was collected in a recovery phase. Maybe the respondents actively participated in follow-up care during the 14-day ESM study, had a high level of control and adhered to lifestyle changes. By participating in follow-up care, dietary advice is more often followed which increases the chance of long-term weight maintenance (Berends & Nederlandse Vereniging voor Heelkunde, 2020; E. Conceição et al., 2021). It also became clear from the interviews that patients needed to regain confidence and rediscover how much food they needed in order to feel satiated, at what times they could eat best and what food they could and could not tolerate since the capacity of their stomach has been significantly reduced as a result of bariatric surgery. Therefore patients might be less inclined towards problematic eating behaviour as this would have a negative impact on their recovery.

Finally, several important points for attention have emerged in this study concerning the usability of an ESM application. Respondents stated that the application was pleasant and easy to use. This allowed respondents to move quickly through the questions, which also corresponds with the average time to complete a questionnaire (64.9 seconds). This is in line with the literature, since an ideal ESM questionnaire should take one to two minutes to complete in order to prevent too much of a burden for the respondents (Inez Myin-Germeys & Kuppens, 2022). However, comments were made about the high frequency of sent questionnaires. Reasons for expired questionnaires

were mainly travel time and work (e.g. irregular shifts), which made it difficult complete all questionnaires during the 14-day ESM study. Furthermore, it was also mentioned by several respondents that they had the impression that the questionnaires were completed on autopilot, since they knew which questions would come, and in what order. However, this phenomenon was mentioned in other ESM studies, which implied that higher questionnaire density may predicts lower compliance (Inez Myin-Germeys & Kuppens, 2022; Van Berkel et al., 2018). However, based on the semi-structured interviews, the high density of questionnaires still resulted in a relatively low response burden. Lastly, another important result from the semi-structured interviews is that some respondents indicated that they became more aware of their emotions and eating behaviour while completing the questionnaires during the two week period. This is an interesting and positive result, since the use of ESM also aims to make respondents aware of their actions by completing the questionnaires at random times (Palmier-claus et al., 2019; Thomas, Bond, et al., 2011).

5.2 Strengths and limitations

One strength of this study is that it is one of the few studies within the post-bariatric population that investigates emotions, problematic eating behaviours and contextual factors using ESM. By using Ethica for questionnaires at random times a day, real-time data about behaviour and emotion can be measured in individuals' natural environment. This allows natural conditions to be explored while respondents are busy with their daily activities, which appears to be very relevant when investigating eating behaviour (Williams-Kerver et al., 2020). The repetitive questions allow the assessments to be collected in diverse situations, providing opportunities for researchers to explore and understand the variability in mental states and psychological compositions (I. Myin-Germeys et al., 2009). In addition, the collection of real-time data prevents participants from answering questions afterwards and limits retrospective and response bias as much as possible (Palmier-claus et al., 2019; Verhagen et al., 2016).

Second, this study examined several forms of problematic eating behaviour (LOC eating, craving, grazing and dietary relapse). Other studies often focus on only one or two types of problematic eating behaviours, such as craving or grazing (Guthrie et al., 2014; Pizato et al., 2017). Lastly, another strength is the use of semi-structured interviews in current ESM study. This way, both quantitative and qualitative data were collected. This allowed the results from the LMMs to be compared with the opinions and visions of the respondents themselves, since the questionnaires consisted of closed questions with a limited number of choices. By asking the respondent personally about their vision by means of open questions, the answers from the ESM questionnaires could be verified which increased the validity of this study.

Besides strengths, this study contains certain limitations. First, the current study measured up to one year after bariatric surgery since patients had surgery in 2022 in ZGT. However, the weight of bariatric patients often stabilizes two years after surgery (Berends & Nederlandse Vereniging voor Heelkunde, 2020). As a result, it was not possible to examine eventual changes in problematic eating behaviour, emotions and contextual factors during a longer two year time period after surgery. Second, compared to other ESM studies this study contained a sample size of 18 respondents, while on average an ESM study contains around 50 respondents (Van Berkel et al., 2017). Despite the smaller sample size in this study, significant results were nevertheless found. Third, not all questionnaires were filled in and it might be that respondents experienced problematic eating behaviour during the times they did not fill in the questionnaire. Research by Amundsen et al. (2016) states that food intake collected through self-reports may suffer from underreporting. So it is possible that respondents completed the questionnaires more positively (e.g., fewer experiences of problematic eating behaviour) than actually was the case. Lastly, by having respondents continuously focus on one aspect of their lives, not only their behaviour is measured but also influenced. This may have a positive effect on the respondents when they are more conscious of their eating behaviour. But it may also have a negative effect on the reliability of the research

results. This phenomenon is also known as measurement reactivity (van Ballegooijen et al., 2016; Van Berkel et al., 2018).

5.3 Future research

For future research, it could be valuable to use the same research method in the preoperative phase. This allows to obtain data in both phases in order to compare the results in different periods within bariatric care. As a result, changes in emotions, contextual factors and problematic eating behaviour can be investigated over a longer time period, whereby the reliability of the study is strengthened by repeated questionnaires from each respondent (Inez Myin-Germeys & Kuppens, 2022). The same applies for the semi-structured interviews in the preoperative phase. These directions for future research were confirmed by the respondents during the interviews; they indicated that they would most likely give different answers to the questions six months postoperatively compared to one year postoperatively. The same argument was given for completing the questionnaires preoperatively.

Furthermore, it is of added value to include a larger target group for both the 14-day ESM study and the semi-structured interviews, in order to increase the validity of follow-up research. In order to make respondents enthusiastic about scientific research, the way in which respondents are recruited can be reconsidered. From this study, it can be concluded that patients are more inclined to participate in scientific research when they are approached face-to-face. Apparently, only an invitation by e-mail or a telephone call in which is mentioned that participation in a scientific study can be realized has no persuasive power for the patients to actually register for the study. Therefore, it might be important to find more options in which patients can be approached. For example, not only an explanation about the study can be given during postoperative group meetings of the dietitian in ZGT, but also preoperatively when patients come together during mandatory group meetings with the dietician and physiotherapist. Or during non-binding group meetings where patients can obtain information about the surgery and counselling program (*Behandeling*, n.d.).

Finally, it may be of added value for future research on emotions and contextual factors in relation to problematic eating behaviours to also monitor weight loss of post-bariatric patients. During this ESM study, problematic eating behaviour was self-reported, but no objective data was collected whether sufficient weight loss was achieved. However, most of the scientific literature is based on weight loss in combination with factors such as calorie-intake, physical activity, follow-up and psychological factors (Campos et al., 2008; El Ansari & Elhag, 2021; S. P. Goldstein et al., 2018). Therefore, by including the changes in weight of bariatric patients in a future ESM study on emotions and contextual factors in relation to problematic eating behaviours, the results may be better comparable to literature and may be more objective.

5.4 Implications

The results of this ESM study lead to several clinical implications. First, the present study suggests that there is an association between hunger and craving and stress and grazing in post-bariatric patients. Therefore, it could be of added value to pay extra attention to the emotions stress and hunger during the ongoing consultations that are scheduled both pre- and postoperatively with patients in ZGT. If a healthcare professional notices or expects that individuals are sensitive feelings of hunger or to stress, e.g. due to personal circumstances, it is important to reflect on the emotions patients show during the consultations. This proactive approach allows healthcare professionals to pay sufficient attention and alertness to the emotions that bariatric patients experience. As a result, forms of problematic eating behaviour may come to light earlier or perhaps be prevented by taking action on the emotions that lead to problematic eating habits.

Second, the use of ESM can perhaps be integrated into the treatment of bariatric patients. The self-reported questionnaires in Ethica could be a valuable signal for professional help when answers given by respondents indicate striking changes in emotion or eating behaviour. Especially when forms of problematic eating behaviour and the emotions stress and hunger are visible that can lead to problematic eating behaviour. Since ESM is suitable for collecting real-time data (Verhagen et

al., 2016), personal consultations (physical or by phone) can be realized quicker in response to the patient's emotions. Moreover, the results of this 14-day ESM study (see Table 2 and 3) and the interviews imply that each individual expresses different emotions and forms of eating behaviour. Therefore, it is important to give meaning to emotions of bariatric patients and provide them with personalized care, which increases the chance of permanent weight loss in the long term (Berends & Nederlandse Vereniging voor Heelkunde, 2020). Finally, through personalized care, increased compliance can be achieved in ESM studies when personal consultations and feedback take place in the field of health and behaviour of respondents (Inez Myin-Germeys & Kuppens, 2022). Literature indicates that ESM makes it easier for patients to recognize the results and translate them into their daily lives during feedback sessions with healthcare professionals (Verhagen et al., 2016). This way, involvement and cooperation are promoted and feelings of strength are heightened in the recovery process of bariatric surgery.

6. Conclusion

The current study aimed to explore the association between emotions and contextual factors in relation to problematic eating behaviour in post-bariatric patients. To the best of the researcher's knowledge, this study is one of few studies that applies ESM to monitor real-time data of patients' emotions and eating behaviours in the post-bariatric phase. By using LMMs, associations have been found between hunger and craving and between stress and grazing. Furthermore, the semi-structured interviews showed insight into the usability of the application Ethica. According to post-bariatric patients, the application was pleasant to use and filling in self-reported ESM questionnaires made them more aware of their eating behaviour. This offers perspective for the use of an innovative technology such as the application Ethica in the aftercare process of bariatric surgery, and perhaps also in the preoperative process.

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8. Appendices

Appendix A Flyer participation ESM study ZGT

Appendix B Brief information brochure ESM study

ESM-studie – informatie voor deelnemers. V1 – 09.12.2021

Beknopte informatie voor deelnemers

1. Doel van de studie

Wij willen onderzoeken wat mensen voelen in het dagelijks leven na een maagverkleining of gastric bypass. Dit willen we meten met een app op de smartphone. Hiervoor is het belangrijk dat u uw normale, dagelijkse routine aanhoudt en dat u uw smartphone altijd bij u heeft.

2. Uitleg onderzoek

Wanneer u mee wilt doen aan het onderzoek, downloadt u een applicatie op uw telefoon. Hiervoor krijgt u de instructies per mail toegestuurd (document 'instructies voor deelnemers – Ethica Data'). Deze app geeft u gedurende 2 weken 6 keer per dag een melding dat er een vragenlijst voor u klaarstaat om in te vullen. Het invullen van de vragenlijst kost u per keer ongeveer 2 minuten. Deze meldingen zijn tussen 8.00 en 21.30 uur op willekeurige momenten. U hoeft niet wakker te blijven of eerder op te staan om geen meldingen te missen. Het is belangrijk om uw normale routine aan te houden. Op dag 1 en dag 15 van het onderzoek wordt er een extra vragenlijst gestuurd. Op de eerste dag zijn dit 5 algemene vragen (geslacht, leeftijd, operatiedatum) en op de 15e dag van het onderzoek is dit een vragenlijst met 33 vragen over eetgedrag. Na 2 weken bent u klaar met het onderzoek.

3. Meldingen

Wanneer u een melding ontvangt van de app (Ethica Data), dan vult u de vragenlijst in. Denk niet te lang na over het antwoord, het gaat erom dat u invult hoe u zich op dat moment voelt.

4. Vragen en de antwoordmogelijkheden

U zult merken dat de vragen over emotie te beantwoorden zijn met een score van 0 tot 10. Hierbij is 0 niet/nee en 10 wel/ja. Door op de balk in uw scherm te tikken kunt u een score kiezen. Het rondje wat dan zichtbaar wordt kunt u ook verschuiven. Als u de vraag ingevuld heeft klikt u op 'volgende' om naar de volgende vraag te gaan. U vult in hoe u zich voelde vlak voordat u de melding kreeg. Ook komen er een aantal vragen over met wie u bent en waar u bent. Kijk goed naar de antwoordmogelijkheden en kies het beste antwoord. Op de vraag 'met wie ben ik' heeft u meerdere antwoordmogelijkheden. Ook is er een vraag 'wat doe ik'. Hier vult u in wat u aan het doen was vlak voordat de app een melding gaf. Als laatste worden er vragen gesteld over bepaald eetgedrag: lees de vraag goed, u moet een antwoord geven over de afgelopen 30 of 60 minuten. Dat staat duidelijk in de vraag vermeld.

5. Gemiste meldingen / notificaties

Het kan voorkomen dat u op het moment van de melding de vragenlijst niet in kunt vullen (bijvoorbeeld omdat u een afspraak heeft of in de auto zit). De vragenlijst blijft nog 15 minuten zichtbaar, deze tijd heeft u nog om de vragenlijst in te vullen. Na 15 minuten verloopt de vragenlijst. Deze is dan niet meer zichtbaar in de app waardoor u deze niet meer in kunt vullen. Dit geldt niet voor de algemene vragenlijst op dag 1 en de vragenlijst over eetgedrag op dag 15. Deze vragenlijsten zijn in te vullen van 9.00 tot 21.00 uur.

6. Aanwezigheid van andere personen

Het kan zijn dat u een melding ontvangt wanneer u met andere personen bent. U hoeft niet in detail te treden. U kunt bijvoorbeeld aangeven dat u meedoet aan een onderzoek waarin emotie wordt gemeten in het dagelijks leven met behulp van een smartphone app.

7. Wat gebeurt er met de resultaten?

De resultaten zullen anoniem geanalyseerd worden. Uiteindelijk zal er een wetenschappelijk artikel geschreven worden.

8. Beloning

U ontvangt geen vergoeding voor deze studie. Wel maakt u kans op een bol.com cadeaubon van €50,- wanneer u ≥ 80% van de vragen invult. Onder iedere 20 deelnemers (met minimaal 80% ingevulde vragen) wordt een cadeaubon verloot. Er wordt contact met u opgenomen als u de cadeaubon gewonnen heeft.

9. Belangrijke punten

- Continueer uw normale dagelijkse routine
- Neem uw smartphone overal mee naartoe
- Beantwoordt de vragen direct nadat u een melding heeft ontvangen van de app
- U geeft zelf antwoord op de vragen, laat dit niet door iemand anders doen
- U kunt zelf kiezen wanneer u meedoet aan het onderzoek., dit betreft een periode van 15 aaneengesloten sagen (u kunt geen pauzes inlassen)
- U kunt altijd per mail contact opnemen met de coördinerend onderzoeker: bij vragen, onduidelijkheden of in het geval van technische problemen, ook ’s avonds of in het weekend

10. Hoe nu verder?

Wanneer u na het ontvangen van deze informatie wilt deelnemen aan het onderzoek ontvangt u een document ‘instructies voor deelnemers – Ethica Data’. Hierin staat beschreven hoe u de app kunt downloaden, hoe u zich kunt inschrijven en hoe u zich voor de studie registreert. U kunt zelf kiezen wanneer u start met het onderzoek. Als u zich vandaag registreert, dan start u morgen met het onderzoek voor 2 weken.

CONTACTGEGEVENS COÖRDINEREND ONDERZOEKER

Bij vragen of onduidelijkheden kunt u contact opnemen met de onderzoeker.

Naam: Ellen Kuipers

Appendix C Instructions installation Ethica Data

‘Emotie en eetgedrag rondom bariatrische chirurgie, gemeten met een smartphone applicatie’ Instructies Ethica Data. V1, 07-12-2021

Geachte heer / mevrouw,

Hartelijk dank dat u geïnteresseerd bent in ons onderzoek. In de proefpersoneninformatie heeft u gelezen over de inhoud van het onderzoek en wat er van u verwacht wordt. Nu krijgt u schriftelijke uitleg over de smartphone applicatie en het installeren van de app. Met deze applicatie worden de vragenlijsten afgenomen.

Het is goed u te beseffen dat u kunt starten met het onderzoek wanneer dat voor u het beste uitkomt. Dat werkt als volgt: voer de stappen onder het kopje ‘voor de start van het onderzoek’ (pagina 2) uit één dag voordat u wilt starten met de studie. Wilt u bijvoorbeeld op dinsdag starten, dan registreert u zich op maandag. Zodoende kan u deelnemen aan het onderzoek wanneer u dat wenst.

Tot slot: onder iedere 20 deelnemers wordt een cadeaubon van bol.com ter waarde van €50,- verloot! Voorwaarde om kans te maken op de cadeaubon is dat u minimaal 80% van de vragen in de app invult over de periode van 2 weken.

Wij hopen u hiermee voldoende geïnformeerd te hebben. Bij vragen kunt u contact opnemen met de coördinerend onderzoeker (zie pagina 3 voor contactgegevens).

Met vriendelijke groet,

Ellen Kuipers, arts-onderzoeker

INSTRUCTIES ETHICA DATA

<u>Installeer de applicatie op uw smartphone</u>

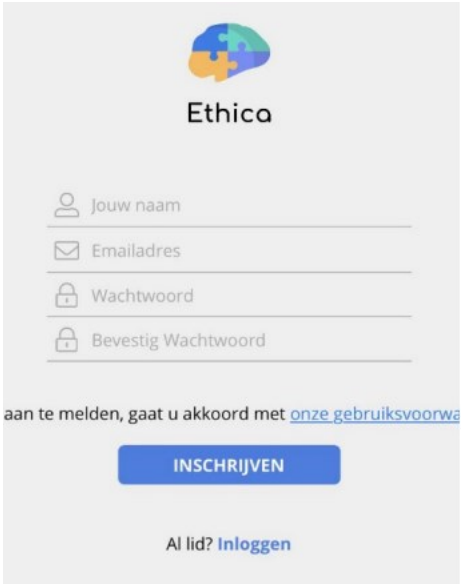
1. ga naar de app store (voor iOS, Apple) of google play store (voor Android) op uw smartphone.
2. Zoek op ‘Ethica’. U herkent de applicatie aan het logo hiernaast.
3. Klik op download. Nu wordt de app geïnstalleerd.

<u>Voor de start van het onderzoek</u>

1. Ga naar de Ethica app. U komt in het beginscherm van de app (zie afbeelding 1).
2. Inschrijven of inloggen:
   a. Heeft u nog geen account? Dan klikt u op ‘inschrijven’. Vervolgens kunt u een account aanmaken door uw naam, emailadres en wachtwoord in te vullen (afbeelding 2). Klik op inschrijven.
   b. Heeft u al een account bij Ethica? Klik op inloggen en vul uw inloggegevens in.
3. Er volgen nu een aantal schermen met korte informatie over Ethica. Op een gegeven moment ziet u het scherm zoals op afbeelding 3.
4. In de balk vult u de 4-cijferige registratiecode in. Deze code is: 1857. Klik op ‘doe mee met studie’.

5. U ziet het scherm zoals in afbeelding 4. Lees de informatie en klik op ‘registreer’ indien u akkoord gaat met deelname.
6. U ziet een scherm met ‘er staat op dit moment geen vragenlijst voor u klaar’. Indien er een vragenlijst voor u klaar staat krijgt u een melding middels een notificatie en/of geluidssignaal. U ontvangt de eerste vragenlijst op de eerstvolgende dag nadat u zich heeft aangemeld (dus niet op de dag van de aanmelding).

Afbeelding 1



Afbeelding 2

Afbeelding 4

Afbeelding 3

<u>Instellingen voor het correct ontvangen van meldingen / notificaties</u>

Voor iOS, Apple:

1. Ga naar de app ‘instellingen’ op uw smartphone en tik op ‘berichtgeving’.
2. Ga naar de Ethica app onder ‘meldingsstijl’.
3. Zet ‘sta berichtgeving toe’ aan en zet ‘strookstijl’ op blijvend. Zet ‘geluiden’ en ‘badges’ aan.

Voor Android:

1. Ga naar de app ‘instellingen’ op uw smartphone en tik op ‘apps’.
2. Ga naar de Ethica app en tik op ‘meldingen’.
3. Klik op ‘meldingen toestaan’.

Let op!

- Zorg ervoor dat u uw geluid en meldingen / notificaties aan heeft staan zodat u daadwerkelijk een melding krijgt wanneer er een vragenlijst klaar staat.
- Het kan zijn dat u geen meldingen meer ontvangt wanneer u een aantal vragenlijsten niet heeft ingevuld. Ga naar de app, dan ontvangt u wel weer meldingen.
- Vul de vragenlijst direct in wanneer u een melding krijgt. Na 15 minuten verloopt de vragenlijst, deze kunt u dan niet meer invullen.
- De Ethica app uploadt automatisch de verzamelde gegevens wanneer er een internetverbinding beschikbaar is (mobiel of wifi). Deze instelling kunt u aanpassen door de optie 'enkel uploaden via wifi' aan te zetten op het instellingenscherm.
- Na het invullen van de vragenlijst kan het voorkomen dat er op het scherm een icoon staat dat weergeeft dat de app aan het laden is (zie de afbeelding hieronder). Wanneer dit nog steeds in beeld staat als u de volgende keer de app opent, dan kunt u de app afsluiten. Dit doet u als volgt:
    - Voor iPhone: Druk snel 2 keer achter elkaar op de thuisknop. Vervolgens veegt u de app over het scherm naar boven. Heeft u geen thuisknop? Veeg dan omhoog vanaf de onderzijde van het scherm. Houd even vast ter hoogte van het midden van het scherm. Veeg de app naar boven om deze te sluiten.
    - Voor Android: druk de thuisknop een aantal seconden in. Vervolgens kunt u de app naar de linker- of rechterkant van het scherm te vegen. Bij sommige toestellen moet u de app naar boven of onderen vegen.

Kans op bol.com cadeaubon

Onder iedere 20 deelnemers wordt er een bol.com cadeaubon ter waarde 50,- verloot. Voorwaarde om kans te maken op de cadeaubon is dat u minimaal 80% van de vragen invult. Indien u de winnaar bent van de cadeaubon wordt u telefonisch of per email ingelicht. Indien u niet gewonnen heeft, dan ontvangt u een email.

CONTACTGEGEVENS COÖRDINEREND ONDERZOEKER

Bij vragen of onduidelijkheden kunt u contact opnemen met de onderzoeker.

Naam: Ellen Kuipers

Appendix D Test subject information ESM study

PROEFPERSONENINFORMATIE VOOR DEELNAME AAN MEDISCH-WETENSCHAPPELIJK ONDERZOEK

EMOTIE EN EETGEDRAG RONDOM BARIATRISCHE CHIRURGIE, GEMETEN MET EEN SMARTPHONE APPLICATIE

Geachte heer / mevrouw,

Wij vragen u om mee te doen aan een medisch-wetenschappelijk onderzoek van het obesitascentrum van ZGT te Almelo en Hengelo. U wordt uitgenodigd om deel te nemen aan dit onderzoek omdat u een bariatrische operatie hebt ondergaan. Deelname is vrijwillig. Om mee te doen is wel uw toestemming nodig. Voordat u de beslissing neemt, is het belangrijk meer te weten over het onderzoek. Lees deze informatie rustig door. Bespreek het zo nodig met uw partner, vrienden of familie. Zijn er nog vragen na het lezen van de informatiebrief? Dan kunt u terecht bij de onderzoeker (E. Kuipers, zie bijlage A). U kunt ook de onafhankelijk deskundige, die aan het eind van deze brief genoemd wordt, om aanvullende informatie vragen.

1.ALGEMENE INFORMATIE
Dit onderzoek wordt uitgevoerd door Ziekenhuisgroep Twente (ZGT) Almelo en Hengelo. De adviescommissie lokale uitvoerbaarheid wetenschappelijk onderzoek van het ZGT heeft dit onderzoek goedgekeurd. Algemene informatie over meedoen aan zo'n onderzoek staat in de brochure 'medisch-wetenschappelijk onderzoek' die u kunt vinden op https://www.rijksoverheid.nl/documenten/brochures/2014/09/01/medisch-wetenschappelijk-onderzoek-algemene-informatie-voor-de-proefpersoon.

2.ACHTERGRON EN DOEL VAN HET ONDERZOEK
Onder bariatrische chirurgie worden alle operaties verstaan die tot doel hebben het gewicht te verminderen. Door het gewichtsverlies zorgen deze operaties meestal voor het verbeteren of voorkomen van gezondheidsproblemen zoals een hoge bloeddruk, gewrichtsklachten en suikerziekte. Voor het bereiken en het behouden van succesvol gewichtsverlies is het belangrijk om uw leefstijl aan te passen en inzicht te krijgen in factoren die van invloed zijn op succesvol gewichtsverlies. Met behulp van een smartphone applicatie is het mogelijk om inzicht te krijgen in emotie en eetgedrag bij patiënten die een bariatrische operatie hebben ondergaan. Wij willen u vragen of u mee wilt doen aan dit onderzoek. De resultaten van dit onderzoek zullen worden gebruikt om in de toekomst de behandeling en begeleiding beter op de individuele patiënt te kunnen afstemmen

3.WAT MEEDOEN INHOUDT
Als u meedoet duurt dat in totaal 2 weken voor u. Gedurende deze periode heeft u minimaal 1 keer een afspraak met de onderzoeker. Deze afspraak vindt telefonisch plaats aan het begin van de studie. Tijdens de telefonische afspraak met de onderzoeker krijgt u uitleg over het onderzoek en het gebruik van de smartphone applicatie. Indien nodig wordt u geholpen bij het installeren van de app.

Het onderzoek betreft een 'observationeel' onderzoek. Dat betekent dat er geen extra behandelingen worden gedaan, maar dat er alleen metingen verricht zullen worden. Van u wordt het volgende verwacht: u wordt gevraagd om een app te downloaden op uw smartphone. Via deze app wordt er per dag zes keer een vragenlijst afgenomen over uw stemming, eetgedrag en omgevingsfactoren. Er wordt van u verwacht dat u antwoord geeft op deze vragen wanneer uw telefoon een signaal geeft middels een bericht of een geluid. Per vragenlijst kost u dat ongeveer 2

minuten. Aan het einde van deze 2 weken wordt er nog een extra vragenlijst over eetgedrag afgenomen via de app. Na twee weken is het onderzoek afgelopen.

4.WAT WORDT ER VAN U VERWACHT

Om het onderzoek goed te laten verlopen is het belangrijk dat u zich aan de volgende afspraken houdt.
De afspraken zijn dat u:

- het onderzoek uitvoert volgens de uitleg zoals onder punt 3 beschreven;
- afspraken nakomt zoals u dat heeft overlegd met de onderzoeker(s);
- als er problemen zijn met de app op uw smartphone;
- als u niet meer wilt meedoen aan het onderzoek;
- als het u niet meer lukt om de afspraken zoals overlegd met de onderzoeker(s) na te komen.

5.MOGELIJKE VOOR- EN NADELEN

Het is belangrijk dat u de mogelijke voor- en nadelen goed afweegt voordat u besluit mee te doen. U heeft persoonlijk niet direct baat bij deelname aan de studie. Het is mogelijk dat dit onderzoek nieuwe inzichten oplevert over emotie en eetgedrag bij bariatrische patiënten, gemeten met een smartphone applicatie. Andere mensen kunnen in de toekomst baat hebben bij informatie uit deze studie. De resultaten kunnen namelijk nuttige gegevens opleveren. Een nadeel van deelname aan het onderzoek kan zijn dat u vragen moet invullen die mogelijk als confronterend ervaren worden.

Deelname aan het onderzoek betekent ook:

- dat u 6 keer per dag een korte vragenlijst invult op uw telefoon waardoor u extra tijd kwijt bent;
- dat u minimaal 1 keer een afspraak heeft met de onderzoeker(s);
- dat u afspraken heeft waaraan u zich moet houden.

Al deze zaken zijn hiervoor onder punt 3 beschreven.

6.ALS U NIET WILT MEEDOEN OF WILT STOPPEN MET HET ONDERZOEK

U beslist zelf of u meedoet aan het onderzoek. Deelname is vrijwillig. Als u besluit niet deel te nemen, hoeft u verder niets te doen. Als u niet wilt meedoen, heeft dit geen invloed op uw behandeling. Als u wel meedoet, kunt u zich altijd bedenken en toch stoppen, ook tijdens het onderzoek. Ook dit zal geen consequenties hebben voor u of uw verdere behandeling. U wordt op de gebruikelijke manier behandeld. U hoeft niet te zeggen waarom u stopt. Wel moet u dit direct melden aan de onderzoeker. De gegevens die tot dat moment zijn verzameld, worden gebruikt voor het onderzoek. Als er nieuwe informatie over het onderzoek is die belangrijk voor u is, laat de onderzoeker dit aan u weten. U wordt dan gevraagd of u blijft meedoen.

7.EINDE VAN HET ONDERZOEK

Uw deelname aan het onderzoek stopt als:

- u het onderzoek zoals beschreven onder punt 3 heeft afgerond;
- u zelf kiest om te stoppen;
- het ziekenhuis of de overheid besluit om het onderzoek te stoppen.

Het hele onderzoek is afgelopen als alle deelnemers klaar zijn.

8.GEBRUIK EN BEWAREN VAN UW GEGEVENS

Voor dit onderzoek worden uw persoonsgegevens verzameld, gebruikt en bewaard. Het gaat om gegevens zoals uw naam, geboortedatum en om gegevens over uw gezondheid. Het verzamelen, gebruiken en bewaren van uw gegevens is nodig om de vragen die in dit onderzoek worden gesteld te kunnen beantwoorden en de resultaten te kunnen publiceren. Wij vragen voor het gebruik van uw gegevens uw toestemming.

Vertrouwelijkheid van uw gegevens

Om uw privacy te beschermen krijgen uw gegevens een code. Uw naam en andere gegevens die u direct kunnen identificeren worden daarbij weggelaten. Alleen met de sleutel van de code zijn gegevens tot u te herleiden. De sleutel van de code blijft veilig opgeborgen in ZGT. In rapporten en publicaties over het onderzoek zijn de gegevens niet tot u te herleiden.

Ethica Data

Tijdens dit onderzoek wordt er gebruik gemaakt van de smartphone applicatie Ethica Data. Ethica Data slaat de verzamelde informatie op in Canada. In Canada gelden vergelijkbare privacy richtlijnen als in de EU. In Canada is de bescherming van persoonsgegevens een fundamenteel recht, waardoor derden niet bij de persoonsgegevens kunnen komen. De verzamelde data met behulp van de Ethica Data app wordt opgeslagen in een database van Ethica Data. Ethica Data maakt gebruik van twee afzonderlijke databases, die zich op twee verschillende servers bevinden. Zo staan de registratiegegevens van een deelnemer (naam en email) op een andere server opgeslagen dan de studiegegevens (de antwoorden die worden gegeven op de vragenlijsten). De studiegegevens bevatten geen expliciete persoonlijke identificatiegegevens. Bepaalde medewerkers van Ethica Data hebben toegang tot de registratiegegevens van de deelnemer om de nodige technische ondersteuning te bieden. Zij hebben geen toegang tot de studiegegevens. Alleen de onderzoekers weten welke studiegegevens van welke patiënt zijn en kunnen de informatie herleiden.

Toegang tot uw gegevens voor controle

Sommige personen kunnen op de onderzoekslocatie toegang krijgen tot al uw gegevens. Ook tot de gegevens zonder code. Dit is nodig om te kunnen controleren of het onderzoek goed en betrouwbaar is uitgevoerd. Personen die ter controle inzage krijgen in uw gegevens zijn bijvoorbeeld: bevoegde medewerkers van dit onderzoek, de commissie die de veiligheid van het onderzoek in de gaten houdt, de Inspectie voor de Gezondheidszorg en Jeugd en controleurs van de Raad van Bestuur van ZGT. Zij houden uw gegevens geheim. Wij vragen u voor deze inzage uw toestemming.

Bewaartermijn gegevens

Uw gegevens moeten 15 jaar bewaard worden in ZGT Almelo en Hengelo. Hierna worden de gegevens vernietigd.

Toestemming voor het gebruik van uw gegevens intrekken

U kunt uw toestemming voor het gebruik van uw gegevens op ieder moment intrekken. Maar let op: trekt u uw toestemming in, en hebben onderzoekers dan al gegevens verzameld voor een onderzoek? Dan mogen zij deze gegevens nog wel gebruiken.

Meer informatie over rechten bij verwerking van gegevens
Voor algemene informatie over uw rechten bij verwerking van uw persoonsgegevens kunt u de website van de Autoriteit Persoonsgegevens raadplegen. Bij vragen of klachten over de verwerking van uw persoonsgegevens raden we u aan eerst contact op te nemen met de onderzoeker. U kunt ook naar de Functionaris voor de Gegevensbescherming van ZGT gaan (zie bijlage A). Of u dient een klacht in bij de Autoriteit Persoonsgegevens.

9.VERZEKERING VOOR PROEFPERSONEN
Als u deelneemt aan het onderzoek, loopt u geen extra risico's. ZGT hoeft daarom geen extra verzekering af te sluiten.

10.GEEN VERGOEDING VOOR MEEDOEN
De extra testen voor het onderzoek kosten u niets. U wordt niet betaald voor deelname aan dit onderzoek. Wanneer u minimaal 80% van de vragen heeft ingevuld maakt u kans op een bol.com cadeaubon ter waarde van €50,-. Onder iedere 20 deelnemers wordt een cadeaubon ter waarde van €50,- verloot.

11.HEEFT U VRAGEN?
Indien u op dit moment of tijdens de studie vragen of klachten heeft, vragen wij u contact op te nemen met de onderzoeker. Als u er behoefte aan heeft, bestaat er ook de mogelijkheid om met een onafhankelijk persoon over dit onderzoek te praten. Dat wil zeggen een persoon die niet betrokken is bij het onderzoek maar wel op de hoogte is van de risico's en de mogelijke voor- en nadelen van dit onderzoek. U kunt zich in dit geval wenden tot dr. Lutke Holzik, zie bijlage A voor de contactgegevens.

12.HEEFT U TWIJFELS OVER DEELNAME?
Deelname aan het onderzoek is een investering en vraagt tijd en ruimte van u. Daarom vinden we het van groot belang dat u zelf een moment kunt kiezen waarop u deelneemt aan het onderzoek. Wanneer u bijvoorbeeld een drukke baan heeft kan het een flinke uitdaging zijn om 6 keer per dag de vragenlijst in te vullen. We bieden u daarom graag de gelegenheid om een zelfgekozen moment te kiezen in de periode januari t/m juni 2022. U kunt uiteraard contact met ons opnemen om eventuele twijfels of vragen te bespreken en samen te kijken of deelname haalbaar is voor u.

13.TOESTEMMING DEELNAME
Indien u na zorgvuldige overweging besluit deel te nemen aan dit wetenschappelijk onderzoek, dan vragen wij u om een email te sturen naar [redacted] (Ellen Kuipers, coördinerend onderzoeker). Vermeld hierin uw naam en geboortedatum en dat u mee wilt doen aan het onderzoek over emotie en eetgedrag, gemeten met een smartphone applicatie. Wij zullen dan contact met u opnemen.

Dank voor uw aandacht.

Met vriendelijke groet,

Ellen Kuipers, arts-onderzoeker chirurgie

VRAGENLIJST EMOTIE EN EETGEDRAG

1. Hoe was de kwaliteit van u nachtrust?

Erg slecht										Erg goed
0	1	2	3	4	5	6	7	8	9	10

Omcirkel per uitspraak het cijfer op schaal van 0 t/m 10 dat **op dit moment** het beste bij uw past. Kies één antwoord.

	Nee									Ja
2..Ik voel me boos/geïrriteerd	0	1	2	3	4	5	6	7	8	9	10
3..Ik voel me angstig/bang	0	1	2	3	4	5	6	7	8	9	10
4..Ik voel me ontspannend/kalm	0	1	2	3	4	5	6	7	8	9	10
5..Ik voel me opgewekt/blij	0	1	2	3	4	5	6	7	8	9	10
6..Ik voel me somber/verdrietig	0	1	2	3	4	5	6	7	8	9	10
7..Ik voel me gespannen/gestrest	0	1	2	3	4	5	6	7	8	9	10
8..Ik verveel me	0	1	2	3	4	5	6	7	8	9	10
9..Ik walg van mezelf	0	1	2	3	4	5	6	7	8	9	10
10..Ik ben moe	0	1	2	3	4	5	6	7	8	9	10
11..Ik heb honger	0	1	2	3	4	5	6	7	8	9	10

12. Met wie ben ik?
    - Partner
    - Kinderen
    - Familie
    - Huisgenoten
    - Huisdier(en)
    - Vriend(en)
    - Collega’s
    - Hulpverleners
    - Bekenden
    - Onbekenden
    - Niemand

13. Wat doe ik?
- Werk
- School
- Huidhouden
- Zelfverzorging
- Zorg voor anderen
- Eten, drinken
- Onderweg, reizen
- In gesprek
- Online contact
- Beweging, sport
- Ontspanning
- Rusten
- Niets
- Iets anders

14.. Waar ben ik?
- Werk
- School
- Thuis
- Bij iemand thuis
- Winkel
- Café, restaurant
- Sportschool
- Zorgplek
- Onderweg
- Buiten
- Ergens anders

15. Heeft u de afgelopen 30 minuten een verlangen gehad naar een specifiek voedingsmiddel? Hoe sterk was dit verlangen? Kies één antwoord op schaal van 0 t/m 10.

Niet										Erg
0	1	2	3	4	5	6	7	8	9	10

16. Heeft u de afgelopen 60 minuten iets gegeten en / of gedronken wat waarschijnlijk van negatieve invloed is op uw gewicht?
- Ja
- Nee

17. Heeft u de afgelopen 60 minuten ongebruikelijke grote hoeveelheden ongezonde voeding gegeten?
- Ja
- Nee

18. Heeft u de afgelopen 60 minuten ongepland en herhaaldelijk kleine hoeveelheden voedsel gegeten buiten de geplande maaltijden en tussendoortjes om?

- Ja
- Nee

Appendix F Questions semi-structured interview ESM study

Vragenlijst telefonisch interview post-bariatrische patiënten ZGT

Semigestructureerd interview

Allereerst bedankt voor uw deelname aan dit telefonische interview.

Mijn naam is Charlotte van den Berg en momenteel ben ik bezig met mijn Master scriptie voor de studie Gezondheidswetenschappen aan de Universiteit Twente. Voor mijn afstudeerscriptie onderzoek ik of er een verband kan worden gevonden tussen emotie en omgevingsfactoren in relatie tot problematisch eetgedrag, gemeten met een smartphone applicatie. Hiervoor heeft u twee weken lang vragenlijsten ingevuld door middel van een smartphone app.

Het doel van dit interview is om de resultaten uit de ingevulde vragenlijsten te vergelijken met de mening van u als persoon. Tijdens de vragenlijst kon u namelijk maar uit een beperkt aantal antwoorden kiezen. Daarom zal ik nu om wat meer verduidelijking van uw antwoorden vragen. Daarnaast zijn wij ook benieuwd naar uw ervaring met de smartphone app.

Zoals voorheen met u is besproken zal ik dit interview opnemen. Het gehele interview zal anoniem worden verwerkt waardoor de antwoorden die u op de vragen geeft niet te herleiden zijn naar u. Na afronding van mijn afstudeeronderzoek zullen de geluidopnames vernietigd worden. Klopt het dat u toestemming heeft gegeven om het interview op te nemen?

Dan zal ik nu starten met de opname.

Open vragen resultaten hypotheses

Hypothese 1

Wij hebben het verband tussen boosheid en het eten van ongebruikelijk grote hoeveelheden ongezond voedsel onderzocht.

Wat is uw ervaring?

Hypothese 2

Wij hebben het verband tussen honger en het verlangen naar een specifiek voedginsmiddel onderzocht.

Wat is uw ervaring?

Hypothese 3

Wij hebben het verband tussen angst en het ongepland en herhaaldelijk eten van kleine hoeveelheden voedsel buiten de geplande maaltijden en tussendoortjes om onderzocht.

Wat is uw ervaring?

Hypothese 4

Wij hebben het verband tussen stress en het eten en/of drinken van iets wat waarschijnlijk van negatieve invloed is op uw gewicht onderzocht.

Wat is uw ervaring?

Hypothese 5

Wij hebben het verband tussen personen die in het gezelschap zijn van anderen en het verlangen naar een specifiek voedingsmiddel onderzocht.

Wat is uw ervaring?

Hypothese 6

Wij hebben het verband tussen personen die thuis zijn en het ongepland en herhaaldelijk eten van kleine hoeveelheden voedsel buiten de geplande maaltijden en tussendoortjes om onderzocht.

Wat is uw ervaring?

Open vragen gebruikersvriendelijkheid applicatie

1. Wat vond u van het gebruik van de applicatie?
2. Hoe heeft u het invullen van de vragenlijsten ervaren?
    - ✓ Wat vond u van de hoeveelheid vragen?
    - ✓ Wat vond u van de hoeveelheid vragenlijsten?
    - ✓ Wat vond u van de hoeveelheid notificaties die de app gaf?
3. Wat vond u van de vragen die gesteld werden?
    - ✓ Waren deze vragen te begrijpen?
    - ✓ Er waren momenten dat u de vragenlijst niet heeft ingevuld. Wat was daar de oorzaak van?
4. Wat vond u ervan dat u geen inzicht had in uw eigen gegevens?
5. Wat zou u er van vinden als we de applicatie gaan gebruiken in het nazorgtraject na een operatie?
    - ✓ Hoe ziet u dat voor u?
6. Zijn er volgens u verbeterpunten mogelijk voor de applicatie wat betreft de inhoud?
    - ✓ Waren er bijvoorbeeld vragen of functies die u mistte in de app die volgens u zouden kunnen helpen bij het veranderen van uw levensstijl? (denk bijv. aan meer uitleg over type voeding, veelvoorkomende emoties/gevoelens na de operatie)

Indien een deelnemer de studie voortijdig heeft afgebroken:

7. Wat was de reden dat u bent gestopt met het onderzoek? Hadden wij een bijdrage kunnen leveren om te voorkomen dat u stopte? Op welke manier?

Dit was de laatste vraag die ik voor u had tijdens dit telefonische interview. **Ik stop nu de geluidsopname.** Nogmaals hartelijk dank voor uw deelname. Heeft u nog vragen of opmerkingen?

Appendix G Visual representation questions application Ethica

Figure 1a.

Demographic question age

Figure 1b.

Demographic question operation date

Figure 2a.

DEBQ day 15

Figure 2b.

DEBQ day 15

Figure 3a.

Emotion relaxed/calm

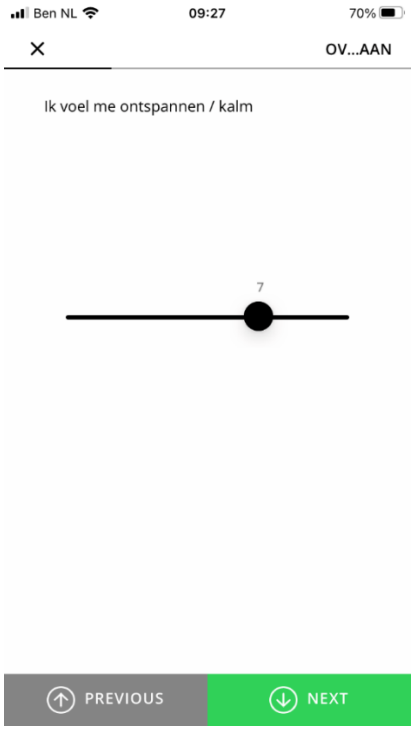


Figure 3b.

Emotion gloomy/sad

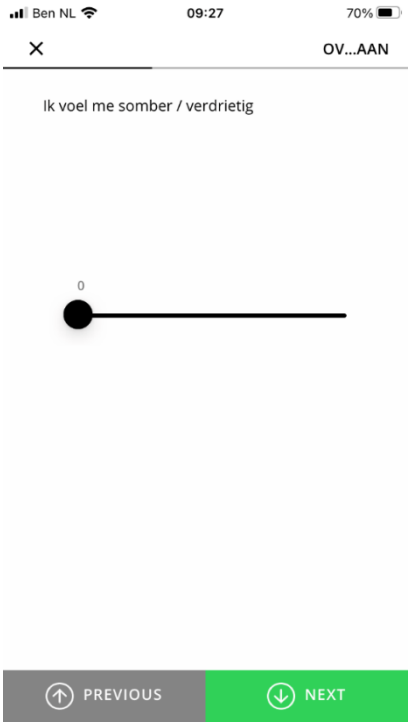


Figure 4a.

Question Activity: 'What am I doing?'

Figure 4b.

Question Place: 'Where am I?'

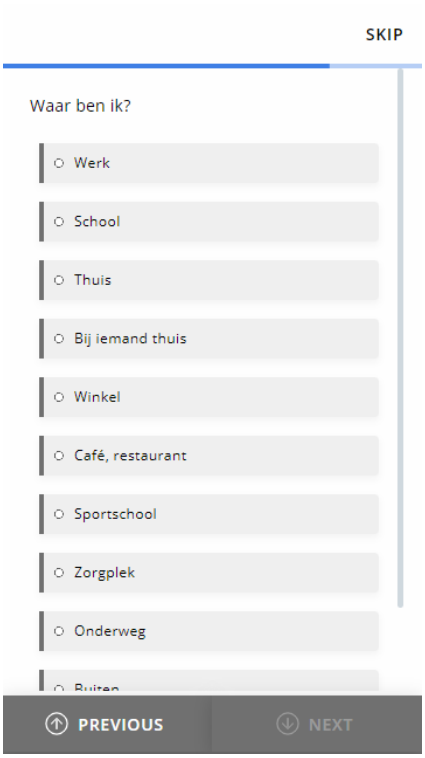


Figure 5a.

Question craving

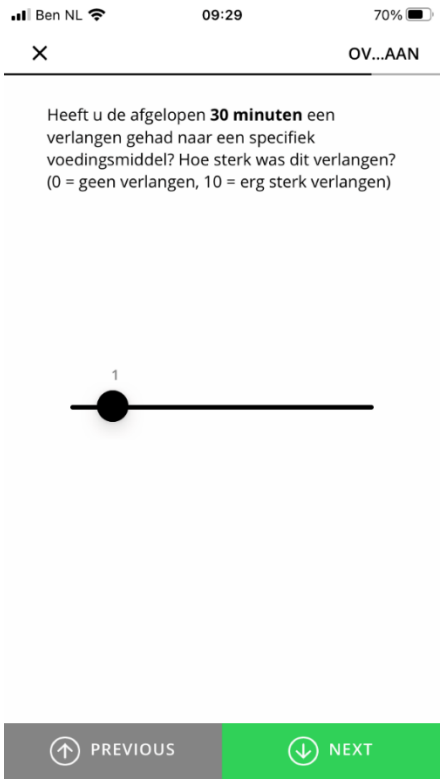


Figure 5b.

Question crazing