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eHealth after bariatric surgery: determining psychological characteristics and needs regarding an eHealth support intervention

Master Thesis Health Psychology & Technology

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Abstract

Background: Bariatric surgery procedures surpass outcomes of traditional weight loss interventions to treat obesity, but a considerable portion of bariatric patients report difficulties in adapting to postsurgical dietary and exercise lifestyle recommendations. Several psychological characteristics are found to be associated with ability to adhere to these recommendations. The aim of study A was to obtain insights in these characteristics, the extent to which they change and their relation with weight loss. An eHealth behavior change support intervention could be an effective postsurgical support tool, but specific bariatric-focused eHealth interventions are lacking. The aim of study B was to determine postsurgical problems and needs and user-requirements of a future eHealth intervention.

Method: In study A, 190 bariatric-surgery awaiting patients completed a preoperative questionnaire in which several psychological variables were surveyed. Six months after they underwent bariatric surgery, 76 participants completed the postoperative survey. In study B, an existing lifestyle support application, VitalinQ, was showed to or tested by 11 participants. A qualitative research design was conducted by semi-structured interviewing bariatric patients and professionals in order to detect problems, attitudes towards eHealth and needs regarding a future eHealth support system. After transcribing the interviews, user-requirements were generated.

Results: The sample of study A reported generally low mental problems and high body image dissatisfaction and food craving. Six months after surgery, the sample showed decreases in BMI, food craving, body image dissatisfaction and diet support. Higher increases in body image dissatisfaction and diet support were found to predict more weight loss after six months. In addition, preoperative higher depression, lower food craving and lower emotional loneliness predicted more BMI reduction. In study B, several eating-related problems emerged. The attitudes towards the concept and idea of the VitalinQ application were positive, yet usability issues and lack of bariatric-focused functions reduced this positivity. Self-monitoring of dietary and exercise behavior, online personalized dietary feedback, challenges, social options and tailored high-protein recipes were the most mentioned eHealth needs that arose.

Conclusion: Study A obtained insights into several psychological characteristics, their change after surgery and their relation with weight loss. Results in study B highlighted the need for bariatric-specific eHealth interventions. Results of both studies should be used as a reference during the development of the future eHealth support intervention, in order to make it tailored to the needs of the target group. User-requirements that were drafted could be used to further develop VitalinQ or to develop a new eHealth intervention. Future developers need to continue conducting mixed-methods, following participatory design approaches, and using the persuasive system design model, to eventually increase adherence, uptake and impact.

Samenvatting

Achtergrond: Bariatrische ingrepen om obesitas te behandelen overtreffen resultaten van traditionele gewichtsverlies interventies. Echter, een aanzienlijk deel van de bariatrische patiënten heeft problemen met het aanpassen aan postoperatieve voeding en levensstijl aanbevelingen. Verscheidene psychologische karakteristieken worden geassocieerd met het vermogen om zich aan te passen aan deze aanbevelingen. Het doel van studie A is om inzicht te krijgen in deze karakteristieken en de mate waarin ze veranderen na de operatie en samenhangen met gewichtsverlies. Een eHealth gedragsverandering-interventie zou een effectief postoperatieve hulpmiddel zijn, maar specifieke bariatrische eHealth interventies ontbreken. Het doel van studie B is hierom het bepalen van postoperatieve problemen, behoeften en user-requirements, die kunnen worden aangepakt en gebruikt in een toekomstige eHealth interventie.

Methode: In studie A hebben 190 patiënten die in afwachting waren voor een bariatrische operatie een preoperatieve vragenlijst ingevuld, waarin verschillende psychologische variabelen werden onderzocht. Zes maanden nadat hun bariatrische operatie hebben 76 deelnemers een postoperatieve vragenlijst voltooid. In studie B werd een bestaande eHealth interventie, VitalinQ, getoond aan of getest door 11 deelnemers. Een kwalitatieve onderzoeksmethode werd uitgevoerd en in semigestructureerde interviews met patiënten en professionals werden problemen, attitudes tegenover eHealth en behoeften in een eHealth interventie bepaald. Na het transcriberen van interviews werden user-requirements opgesteld.

Resultaten: De steekproef van studie A rapporteerde over het algemeen weinig mentale problemen en hoge lichaamsbeeld ontevredenheid en voedsel craving. Na zes maanden vertoonde de steekproef afnames in BMI, voedsel craving, lichaamsbeeld ontevredenheid en zelf-gerapporteerde dieet ondersteuning. Hogere toenames van lichaamsbeeld ontevredenheid en dieet ondersteuning voorspelden meer gewichtsverlies. Daarnaast voorspelden hogere preoperatieve depressie, lagere voedsel craving en minder emotionele eenzaamheid meer BMI afname. In studie B kwamen verschillende eet-gerelateerde problemen naar voren. Attitudes ten opzichte van het concept en idee van VitalinQ waren positief, maar problemen met het gebruiksgemak en het gebrek aan bariatrische functies verminderden deze positiviteit. Zelfmonitoring van voedings- en bewegingsgedrag, online gepersonaliseerde voedings-feedback en eiwitrijke recepten, challenges en sociale opties waren de meest genoemde behoeften voor een toekomstige eHealth interventie.

Conclusie: In studie A werden inzichten in psychologische karakteristieken, de mate van veranderingen na de operatie en de relatie met gewichtsverlies verkregen. Resultaten in studie B benadrukten de behoefte voor een specifieke bariatrische eHealth interventie. De resultaten van beide studies kunnen worden gebruikt tijdens de ontwikkeling van een toekomstige eHealth ondersteunings-interventie, om het zo op de behoeften van de doelgroep af te stemmen. User-requirements dat zijn opgesteld kunnen worden gebruikt tijdens doorontwikkeling van VitalinQ of nieuwe interventies. Toekomstige ontwikkelaars zouden moeten doorgaan met het uitvoeren van gemixte methodes, het volgen van participatieve design methodes, en het gebruiken van het persuasieve systeem model, om uiteindelijk adherentie, opname en impact te vergroten.

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Introduction

The prevalence of worldwide obesity is growing exponentially and traditional weight loss interventions generally have poor long-term outcomes. Bariatric surgery is a way to treat severe obese patients, through altering or interrupting their digestive system, allowing patients to restrict their food intake. Bariatric surgery procedures are generally associated with positive health outcomes that far surpass those of traditional weight loss interventions. However, a considerable proportion of the patients report difficulties in adapting to their new lifestyle and fail to achieve maintained positive health outcomes. Technology in the form of an eHealth behavior change support intervention could be a useful and cost-effective postsurgical support tool. Yet, specific bariatric-focused eHealth interventions are lacking. The current study will therefore be a preliminary study for the development of a bariatric support technology. To develop a future technology that matches needs of the target group, the first part of this study aims to obtain insights into the psychological characteristics of bariatric patients, by using quantitative psychological surveys. In addition, the second part of this study will use a qualitative interview design to determine problems, attitudes against eHealth, and needs and preferences regarding a future eHealth technology. This introduction will initially describe obesity and its prevalence, causes and consequences. It continues to describe several weight loss interventions, including bariatric surgery and its advantages. Subsequently, it will explain why bariatric patients need support after surgery in order to succeed in losing weight, and what the potential added value of technology could be in this process. Finally, it will describe the aim of the present study and its research questions.

1.1. Obesity, prevalence and causes

The World Health Organization (WHO) defines overweight or obesity as a condition with abnormal or excessive fat accumulation that presents a risk to health. The Body Mass Index (BMI) is often used to classify overweight and obesity in adults. It is a method to estimate body fat mass by dividing a person's body weight in kilograms by the square of his or her height. Using the BMI as an index, a subdivision can be made between overweight (BMI 25.0 – 29.9 kg/m²), obesity (BMI 30.0 – 39.9 kg/m²) and severe or morbid obesity (BMI ≥ 40.0 kg/m²) (WHO, 2000).

The prevalence of overweight or obesity in both developed and developing countries is rising rapidly (Lobstein, 2015) and has reached epidemic proportions (van Hout, Vreeswijk, & van Heck, 2008; WHO, 2000). Rapid economic growth and urbanization with changing dietary patterns and sedentary lifestyles as side effects, resulted in this major increase of overweight and obese people worldwide in the past decades (Romieu et al., 2017). The prevalence of worldwide obesity has tripled since 1975 and can nowadays be seen as a global public health problem, outpacing hereby more traditional public health threats such as infectious diseases and undernutrition (WHO). In the Netherlands, 48.7% of the adult population in 2017 was overweight and 13.9% of the population did even meet obesity criteria (CBS). Obesity percentages are the highest in the United States, where over one-third (36.5%) of the adults was obese in 2015 – 2016 (Hales, Caroll, Cheryl, & Ogden, 2017).

Regarding the causes of obesity, in a simple way it can be stated that it is caused by overconsumption and a lack of exercise. When energy through calorie intake exceeds energy needed for normal activities and exercise, an energy misbalance arises. Excess energy will be deposited as body tissue, which result in obesity development (Anderson et al., 2015). However, development of obesity depends on many more factors and has a complex mixture of genetic, environmental, cognitive, social, cultural and psychological influences (Heitmann et al., 2012). Genetic disposition differs a lot within people and plays a major genetic role in obesity susceptibility (Heitmann et al., 2012). Increased package sizes, increased quantity of available food and high fat foods are examples of important environmental influences of obesity (Brantley, Myers, & Roy, 2005; Culter, Glaeser, & Shapiro, 2003). In addition, a growing body of literature did find evidence for social influences such as relationships on obesity development (Pachucki & Goodman, 2015; Oliveira, Rostila, de Leon, & Lopes, 2013). Lastly, several psychological factors have been linked to overweight or obesity, but literature is unclear in whether these factors are causes or consequences. For this reason, psychological causes and consequences will be explained in a separate *psychological factors and obesity* section.

1.2. Consequences of obesity

Now that the prevalence and causes of obesity have been discussed, this section continues with providing the broad variety of consequences of obesity. Being overweight or obese could have major consequences for a person's health. Both overweight and obesity are associated with significant higher mortality (Picot et al., 2009; Flegal, Kit, Orpana, & Graubard, 2013). Obesity even outranked tobacco use and became the leading preventable cause of death (Taksler, Rothberg, & Braitwaite, 2014). High BMI levels even led to over 3.9 million deaths in 2015 globally (Forouzanfar et al., 2015). In addition to increased mortality, obesity is generally associated with several physical and psychosocial comorbidities and a poorer quality of life (Van Hout et al., 2003). Risks of these comorbidities increase as the BMI or the abdominal circumference increases (Gezondheidsraad, 2003). Physical comorbidities that are mostly associated with obesity are diabetes mellitus type 2, cardiovascular diseases, several types of cancer, chronic kidney disease, gall bladder disorders, musculoskeletal disorders, respiratory disorders and infertility (Gezondheidsraad, 2003; Kent et al., 2016; Sjöström et al., 2009; Wormser et al., 2011). Having obesity might also contribute to the manifestation or aggravation of several psychological consequences, which will be explained in the section below. Furthermore, less social support, unequal treatment, stigmatization and emotional distress as a result of their overweightness are often mentioned social consequences that obese people report frequently (Puhl & Brownell, 2006; Carr & Friedman, 2006; Rogge et al., 2004). They also experience considerably higher levels of interpersonal and work-related discrimination than others, even when is controlled for socioeconomic confounders (Carr & Friedman, 2006). Evidence for discrimination and prejudice has been found to start among children as young as six years of age (Wadden & Stunkard, 1985).

Lastly, in addition to the physical and psychosocial consequences of obesity on the personal level, there are economic consequences that are relevant for societies. Obese people use considerably more healthcare services because of their large number of comorbidities, leading to increased costs in health care (Keating, Moodie, & Bulfone, 2012). Furthermore, cost emerged from work incapacity and absenteeism at work are frequently mentioned consequences of obesity (Neovius, Johansson, Klark, & Neovius, 2009).

1.3. Psychological factors and obesity

Literature provides various psychological factors that are related with obesity. However, as previously stated, it is unclear whether these factors are causes or consequences of obesity. For example, psychological disorders as anxiety and depression might influence obesity development because they might impede healthy food consumption and exercising (Collins & Bentz, 2009; Blaine, 2008). However, obesity itself is also often found as a factor that caused the manifestation of these mental disorders within obese people (Luppino et al., 2010). Other psychological factors are often mentioned causes or consequences of obesity are body image dissatisfaction, low self-compassion, binge eating and night eating syndrome, low self-esteem and low health-related quality of life. (Weinberger, Kersting, Riedel-Heller, & Luck-Sikorski, 2017; Lazzeretti et al., 2015; Braun, Park, & Gorin, 2016; Fontaine & Barofsky, 2001).

1.4. Weight loss interventions

Because of the increasing prevalence and the variety of consequences of obesity on a personal and societal level, there is need for interventions aimed at treating obesity through reducing weight. Losing even a modest amount of weight can already significantly reduce health risks associated with obesity (Wing et al., 2011). Many obese individuals have already made several weight loss attempts, resulting generally in little or no success (Collins & Bentz, 2009). Participating in weight loss interventions could be another way to reduce weight. Available weight loss interventions vary from diet and exercise interventions, pharmacological interventions and behavior modification therapies (Avenell, Broom, Brown, Poobalan, & Aucott, 2004). Participating these interventions or combinations of interventions might initially induce some weight loss, but for the majority of obese individuals it has appeared to be not effective in causing sustained weight loss on the longer term, which is especially the case for severe or morbid obese individuals (Elfhag & Rossner, 2005; Fobi, 2004).

1.5. Bariatric surgery

Because of the poor long-term outcomes of traditional weight loss interventions, bariatric surgical options to enhance weight loss increase in popularity. Bariatric procedures aim to reduce food intake by physically restricting the gastric capacities of the body (Colquitt, Picket, Loveman, & Frampton, 2014). They are generally far more clinically effective and cost-effective in the treatment of obesity and its comorbidities than non-surgical procedures (RIVM, 2012; Picot et al., 2009; Colquitt et al., 2014) and are even considered to be the only long-lasting treatment of morbid obesity (NIH conference, 1991). An exponential growth in the number of executed bariatric procedures in the last decades is visible (Lo Menzo, Szomstein, & Rosenthal, 2014). According to an overview of Angrisani and colleagues (2017), a total number of 579.517

bariatric surgical procedures have been performed worldwide in 2014, indicating an ongoing increase in the annual number of bariatric procedures (Buchwald & Oien, 2009; Buchwald & Oien, 2013; Angrisani, Santonicola, Iovino, Formisano, Buchwald, & Scopinaro, 2015). Roux-en-Y gastric bypass (39.6%), sleeve gastrectomy (45.9%) and adjustable gastric banding (7.4%) emerged as the most common executed bariatric surgery procedures (Angrisani et al., 2017).

The exponential growth of bariatric procedures can be attributed to the increased awareness of advantages of bariatric surgery over traditional non-surgery interventions. Bariatric surgery procedures are far more effective in achieving and maintaining weight loss, and mortality rates are significantly lower in the surgery treated obese group (Buchwald & Oien, 2009; Adams et al., 2007). In addition, surgical procedures appeared to be effective in improving or resolving several physical comorbidities, including diabetes mellitus type 2, cardiovascular diseases and several types of cancer (Buchwald et al., 2009; Vetter, Cardillo, Rickels, & Igbal, 2009; Adams et al., 2009). Lastly, several psychological comorbidities including anxiety, depression and eating disorders (Sanchez Zaldivar, Arias Horcajadas, Gorgojo Martinez and Sánchez Romero, 2009) and psychological factors as body image, self-esteem, self-concept and health-related quality of life appeared to improve in obese people following a bariatric surgery (Kubik, Gill, Laffin, & Karmali, 2013; Andersen, Aasprang, Karlsen, Natvig, Våge, & Kolotkin, 2015).

1.6. Postoperative lifestyle recommendations

Despite that bariatric surgery processes have been shown to help improve or resolve many obesity-related conditions, they cannot be considered as the "miracle cure" (McGrice & Don Paul, 2015). Weight loss successes depend on many more factors than surgery alone. Bariatric surgery requires patients' lifelong behavioral changes in order to obtain benefits. To enhance positive health outcomes and decrease risks after surgery, several postsurgical lifestyle changes are required, including adherence to a healthy well-balanced diet, adopting an active lifestyle with regular physical activity and taking nutrient supplements (McGrice & Don Paul, 2015; Richardson, Plaisance, Periou, Buquoi, & Tillery, 2009; King & Bond, 2013). However, many patients fail to adhere to these prescribed post-surgery behavioral recommendations (Elkins, Whitfield, Marcus, Symmonds, Rodriguez, & Cook, 2005). Whether this happens deliberately or not is questionable. However, in a study of Madan and Tichansky (2005) it is concluded that a majority of patients do not remember most preoperative education facts after their surgery. This could indicate that adherence failure can be contributed to lack of knowledge.

Failure to adhere to post-surgery physical activity guidelines is one of the most frequently cited non-adherence after surgery (Elkins et al., 2005). Several studies found that despite improved physical functioning arising from bariatric surgery, a considerable part of the patients were even less active one year after surgery than they were before (King et al., 2012; Toussi, Fujioka, & Coleman, 2009). In addition, a majority of patients experience problems with adopting the recommended eating guidelines (Boeka, Prentice-Dunn, & Lokken, 2010), which include a diet rich in proteins, small portion sizes, six meals a day, avoiding of non-easily digestible food, chewing longer, taking nutrient supplements and drinking at least

1500 ml fluid every day, although not 30 minutes before and 30 to 60 minutes after meals (Kostecka & Bojanowska, 2017; Aills, Blankenship, Buffington, Furtado, & Parrot, 2008). Also, compliance with nutrient supplements is often low (Ziegler, Sirveaux, Brunaud, Reibel, & Quilliot, 2009). Failure to meet recommended eating guidelines could lead to less than expected weight loss, weight regain or nutrition deficiencies (Sarwer, Dilks, & West-Smith, 2011). Moreover, dumping syndrome, caused by food emptying too quickly from the stomach, occurs often as a result from overconsuming or consuming sugars and high-fat food (Richardson et al., 2009). Symptoms of dumping syndrome vary per person and include nausea, abdominal cramps, diarrhea, sweating, dizziness, palpitations, vomiting, decreased consciousness and an intense desire to lie down (Ukleja, 2005).

Psychosocial characteristics affect patients' ability to adapt to postoperative lifestyle recommendations (Wimmelmann, Dela, & Mortensen, 2014). Numerous studies already have been done to identify preoperative characteristics that influence bariatric surgery outcomes (i.e. weight loss) (Sheets et al., 2015). At first, *adherence to diet and exercise recommendations* emerged as a predictor for weight loss (Sheets et al., 2015; Livhits et al., 2011). Also, *eating and exercise-related self-efficacy* is found to be strongly associated with corresponding weight loss behaviors (Linde, Rothman, Baldwin, & Jeffery, 2006). The majority of patients report higher eating and exercise-related self-efficacy after surgery than they did before (Larsen, van Ramshorst, Geenen, Brand, Stroebe, & van Doornen, 2004). *Depressive symptoms* have been found as a risk factor for noncompliance with diet and exercise recommendations, and therefore emerged to predict lower amount of weight loss (DiMatteo, Lepper, & Croghan, 2000). In contrast, a study of Averbukh and colleagues (2003) found a greater amount of weight loss among more depressed individuals. *Body image dissatisfaction* is found to predict post-surgical weight loss, by working as a motivator to participate in healthy behaviors (Heinberg, Thompson, & Matzon, 2001). Body image is found to improve after surgery and impacts someone's quality of life (Nickel, Schmidt, Bruckner, Büchler, Müller-Stich, & Fischer, 2017). Patients before surgery report significantly higher overall *food craving* than normal weight controls (Leahey et al., 2012). Food craving is found to be associated with poor compliance to recommended post-surgical behaviors and is therefore a negative predictor of weight loss (Sudan, Sudan, Lyden, & Thompson, 2017). Another characteristic that is found to predict post-surgical weight loss is *self-compassion*, being kind and understanding toward oneself in instances of inadequacies and failures rather than being self-critical (Neff, 2003). In a meta-review of Braun and colleagues (2016), self-compassion is found to operate as a protective factor towards body dissatisfaction and disordered eating behaviors. Self-compassionate individuals are better able to cope after breaking their diet, resulting in not increasing food intake even more (Adams & Leary, 2007). Lastly, several studies investigated the influence of *social support* on weight loss (Livhits et al., 2011). Support group attendance was associated with greater weight loss, but literature remains inconclusive in determining impact of other forms of social support.

It is clear that bariatric patients must change their lifestyle to adhere to postoperative lifestyle recommendations, in order to achieve and maintain weight loss. Behavior Change Theories attempt to predict change to recommended health-related behaviors such as healthy diet or engaging in regular

physical activity, therefore it is also interesting to mention these theories. The Theory of Planned Behavior (TPB) is one widely-used model that aims to predict health-related behavior (Ajzen, 1991). According to this model, intention to perform a behavior is the most important predictor of health behavior. In turn, intention is determined by three constructs: attitude, subjective norms and perceived behavioral control (or self-efficacy). Another behavior change model that focus on intention is the Transtheoretical Model (TTM), often referred to as stages of change model (Prochaska & Velicer, 1997). This model is often related to dietary behavior (Greene, Rossi, Rossi, Velicer, Fava, & Prochaska, 1999). The TTM describe five stages that individuals go through while attempting to change behaviors: precontemplation (no intention to change), contemplation (thinking about change), preparation (intention and planning to change), action (recently changed), and maintenance (performed new behavior over six months). Social support is very important to prevent lapses that could occur in the action and maintenance stage (Prochaska & Velicer, 2001). Others are also important in Bandura's Social Cognitive Theory (SCT) (Bandura, 1986), as this theory states that learning occurs in a social context with a reciprocal interaction between person, environment and behavior. According to the SCT, change towards health-related behaviors is facilitated by a persons' perspective on his outcome expectancies, self-efficacy and behavioral capability. This theory suggests that individuals behave healthy when they receive reinforcement from connecting behaviors such as healthy eating to valued outcomes such as improved health, whilst having the confidence that they are able to complete the behavior.

1.7. Mechanism and potential added value of technology

To optimize positive outcomes and reduce negative outcomes after surgery, many bariatric patients need support in overcoming previous mentioned difficulties and in adapting successfully to new lifestyle recommendations (McGrice & Don Paul, 2015). Regular post-surgery assessments and interventions appeared to have positive outcomes for bariatric patients after surgery (McGrice & Don Paul, 2015). Intensive exercise interventions did prove to be successful in increasing physical activity (Shah et al., 2011) and regular post-surgery dietary counseling interventions appeared to help patients adopt new healthy eating behaviors (Sarwer et al., 2011). Also interventions that target eating and exercise-related psychological factors seem to benefit bariatric patients after surgery (Kalarchian & Marcus, 2015). However, since the number of bariatric surgery treatments is increasing rapidly, healthcare providers struggle to give the recommended level of post-operative care due to time and money constraints (Funnell, Anderson, & Ahroni, 2005). There is need for less intensive and more cost-effective interventions that can be spread more widely among bariatric patients.

Technology in the form of eHealth has the potential of delivering cost-effective interventions to a broad range of participants (Elbert et al., 2014). It could motivate people to actively self-manage their own health and behaviors (Barello et al., 2015). Moreover, it offers the opportunity to provide interventions that are tailored to the needs and characteristics of users, something that already has proven to benefit weight loss interventions (Kroeze, Werkman, & Brug, 2005). Since post-surgery patients require life-long self-

management and the prevalence of bariatric procedures is increasing, implementing eHealth in bariatric aftercare seems like a logical replacement of traditional intensive interventions. However, no eHealth interventions are yet available that are specifically aimed at supporting bariatric patients after surgery.

In the current study, it is hypothesized that eHealth has potential added value in supporting bariatric patients after surgery, because of the positive outcomes of eHealth interventions for comparable patient groups. Specifically, in a systematic review of Van der Meij, Anema, Otten, Huirne and Schaafsma (2016) towards the effectiveness of eHealth after other forms of surgery, eHealth interventions appeared to lead to similar or improved clinical patient-related outcomes compared to regular face-to-face care. Another review of Fanning, Mullen and McAuley (2012) concluded that mobile devices were effective tools for increasing physical activity. Moreover, previous meta-analyses already did show positive results of the use of eHealth interventions in reducing of maintaining weight in obese individuals, compared to minimal interventions (Neve, Morgan, Jones & Collins, 2010; Hutchesson et al., 2015). Especially online interventions that incorporate self-monitoring of body weight, dietary intake and amount of physical activity have been related with greater weight loss outcomes (Burke, Wang, & Sevick, 2011; Painter et al., 2017). Adding personalized (dietary) feedback, goal-setting and social support also appeared to benefit online weight loss interventions (Collins, Morgan, Hutchesson, & Callister, 2013; Pearson, 2012). Furthermore, the addition of extra technologies such as text messages, periodic prompts and reminders, self-monitoring devices and mobile applications seems to enhance weight loss (Hutchesson et al., 2015; Fry & Neff, 2009).

1.8. The present study

Because of the possible added value of using technology to support bariatric patients, yet the current lack of available technology, an eHealth behavior change support system (Oinas-Kukkonen & Harjumaa, 2009) will be developed. This eHealth intervention will be aimed at post-surgical patient support in adapting to new lifestyle behaviors (e.g. healthy diet, exercise and nutrient supplementation) and at supporting positive outcomes after surgery (e.g. weight loss). To support the design of this future intervention, the present study will focus on executing a needs assessment among bariatric patients. A needs assessment can be defined as a process to determine and address needs of a target group (Kaufman, Rojas, & Rossett, 1993). Following user-centered design principles such as the CeHRes roadmap (van Gemert-Pijnen et al., 2011), including prospective users and other stakeholders in early phases of the design process will eventually increase uptake, impact and adherence of interventions. Therefore, in this study, participatory design principles will be followed and bariatric patients and other stakeholders who are involved in bariatric aftercare will be involved during this needs assessment. The present study is subdivided into two sub studies, which will both be explained in more detail below. Study A will use a quantitative survey approach to describe pre and post-operative psychological characteristics of bariatric patients and to examine the associations between these characteristics and weight loss. Study B will use a qualitative approach to determine problems, needs, preferences and attitudes regarding eHealth interventions.

1.8.1. Study A

For an eHealth technology to be accepted, adopted and adhered to by the prospective users, it is necessary for the technology to fit with psychological characteristics of the target group (Van Gemert-Pijnen, Kelders, Kip, & Sanderman, 2018). The first study will therefore focus on obtaining insights into psychological characteristics of bariatric patients before and after surgery, and their associations with weight loss. The aim of this study is to obtain a broad picture of the target group, which can be used as a reference during the development of an eHealth technology. To eventually develop a behavior change support intervention, it is useful to know what the eating and exercise-related problematic characteristics are and whether there are mental problems among the target group that acquire attention. In addition, it is useful to identify characteristics that are positively or negatively associated with weight loss. Insights herein will provide guidelines for detecting individuals that require additional support and will provide guidelines for features that should be implemented in an eHealth tool.

As previously stated, adherence to lifestyle recommendations, depressive symptoms, food craving, eating and exercise-related self-efficacy, body image, self-compassion and social support could be important characteristics that predict post-surgical outcomes (Sheet at al., 2015; Wimmelmann et al., 2014; Linde et al., 2006; Sudan et al., 2017; Braun et al., 2016; Livhits et al., 2011). However, available literature remains inconclusive about the extent to which these factors change after surgery. The current study will therefore build further on these findings by aiming to obtain a broad insight in preoperative psychological and social characteristics of bariatric patients and the extent to which they predict preoperative BMI and postoperative weight loss. Furthermore, this study will look at the changes of these variables from pre to post-surgery, and whether these changes are associated with weight reduction. More concretely, study A aims to answer the following research questions:

1. What are the preoperative characteristics of surgery-awaiting patients and how are they associated with preoperative BMI?
2. Which preoperative characteristics predict weight reduction at six-month post-surgery?
3. Do these characteristics change after surgery, and are changes associated with weight loss?

Based on literature provided in previous sections of the current study, it is hypothesized that more self-compassion, higher body image dissatisfaction, lower loneliness, lower food craving, more support, more exercise behavior and more eating and exercise self-efficacy will be associated with more post-surgical weight loss. Literature varies about the influence of depression on weight loss. In addition, it is hypothesized, based on findings in previous studies, that food craving, body image dissatisfaction and depressive symptoms will decrease (Leahey et al., 2012; Nickel et al., 2017; Kubik et al., 2013). Literature remains inconclusive about differences in physical activity behaviors after surgery (Herring et al. 2016). In the current study, it is hypothesized that exercise behavior will increase, due to improved physical functioning that resulted from surgery. Lastly, literature lacks about the change of social support after bariatric treatments. However, based on studies towards social support after other forms of recovery, it is hypothesized that social support will decrease after surgery. For example, in a study of Neuling and

Winefield (1988) towards frequency of social support after breast cancer surgery, patients' self-reported supportive behaviors were found to decrease as time from surgery passed.

1.8.2. Study B

The second study will use a qualitative interview design to examine eHealth needs and attitudes towards eHealth among bariatric patients. In this phase, qualitative interviews with bariatric patients and other key stakeholders involved in bariatric aftercare will be conducted to determine current problems or barriers after surgery, and needs and preferences that stakeholders deem important related to goals and functions of a future eHealth intervention. To operationalize this process, this study will use an existing healthy lifestyle support application: VitalinQ. This eHealth application fits with the literature, since it targets diet and physical activity and contains self-monitoring, personalized dietary feedback and goal-setting. These features previously appeared to benefit efficacy of eHealth interventions that target weight loss. A detailed description of this application will be given in the *method* section. Bariatric patients and other stakeholders will be provided with this prototypical application. After an explanation or a testing period, they will be interviewed about their first impression of such a support system, its different features and about other values they deem important in a future bariatric support application. Furthermore, user-experiences of VitalinQ will be determined. Specifically, the following research questions will be answered in the second part of the present study.

4. Which problems and barriers of bariatric patients after surgery emerge from qualitative interviews with bariatric patients and other stakeholders, which can be addressed by an eHealth intervention?
5. What are the user-experiences of VitalinQ and what are other needs and preferences regarding an eHealth intervention?

Figure 1 provides a visual overview of the sub studies.

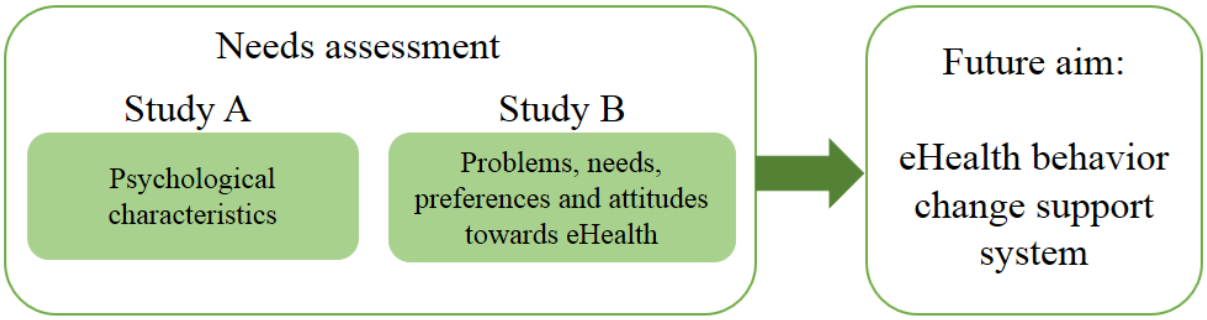

Figure 1. Visual overview of the present study

Method study A

Study design and ethical approval

The first study is a preliminary study and is part of a larger research project that aims to integrate psychology into bariatric surgery, the BARIA-cohort study. The BARIA study is a prospective longitudinal cohort study that uses psychological surveys to obtain insights in the pre- and postoperative psychological profile of bariatric patients. In the current study, participants had completed psychological questionnaires of the first two measurement points; preoperative and six-month post-operative. This prospective cohort survey design was appropriate for examining psychological characteristics that predict or are associated with short-term weight loss after bariatric surgery, and the extent to which these characteristics change from pre-surgery to six months follow-up. Prior to the onset of the study, the Medical Research Ethics Committee (MREC) did assess whether the study conforms ethical standards and provided ethical approval for this study, reference number metc2015_357. The study was conducted according to the World Medical Association (WMA) Declaration of Helsinki principles.

Participants

Participants were recruited through purposive sampling (Tongco, 2007) from the department of Bariatric surgery and Internal Medicine from the Medical Centre (MC) Slotervaart in Amsterdam, the Netherlands. Participants were here on the waiting list for undergoing bariatric surgery. Bariatric surgery is available on MC Slotervaart for people that meet several criteria. Patients who met these criteria were eligible for the present study. Surgeons, internists, psychologists, dieticians and anesthetists of MC Slotervaart determined whether patients are suitable for undergoing bariatric surgery. Eligible individuals should have a BMI ≥ 40 kg/m² or BMI of 35-40 kg/m² with weight-related comorbidity (diabetes type 2, sleep apnea, high blood pressure, arthrosis and high cholesterol), should be aged between 18 and 60, and patients must have done multiple professionally guided weight loss attempts that did not result in weight loss or weight loss maintenance prior to the surgery. In addition to these criteria, patients had to sign informed consent in order to participate in the current study.

Procedure

All bariatric surgery awaiting patients from MC Slotervaart that met the inclusion criteria were invited to participate in the BARIA study. Patients were informed that their participation was anonymous, voluntary and would have no effect on follow-up treatment. They did not receive a compensation for participation. The preoperative measuring point took place approximately one month before the bariatric surgery, during a regular preoperative hospital visit. During this visit, participants completed online questionnaires on tablets provided by the hospital, targeting demographic characteristics and psychological variables described below. In addition, BMI data was assessed. Approximately one month after this first assessment, participants underwent Laparoscopic Roux-Y gastric bypass surgery (LRYGB), a type of bariatric surgery in which the upper section of the abdomen is reduced through small incisions (Figueredo & Yigit, 2006)

(see Figure 2). LRYGB procedures reduce the amount of fat and calories that patients absorb from food, and allow patients to restrict their food intake. The postoperative measuring point took place approximately six months after surgery. Participants were provided with psychological questionnaires that could be completed online or on paper. They submitted the questionnaires online or brought the completed survey to their six-month postoperative hospital visit.

Figure 2: gastric bypass surgery (Schigt et al., 2013).

Variables and materials

Several variables have been measured at pre- and post-surgery, which will all be further described below in this section. The main surgery outcome that was used as a dependent variable in the current study was BMI. Moreover, several Dutch versions of instruments were merged to measure the independent variables depression, self-compassion, food craving, body-image, social support, exercise behavior, and eating- and exercise-related self-efficacy. In addition, demographic data was obtained by questions about age, gender, birth data and place, ethnicity, marital status, education and work, present in both the preoperative and the postoperative surveys. Because of the rather lengthy length of the preoperative survey, some variables were removed or were replaced by a validated shortened version of the original in the postoperative survey.

BMI

BMI is an index for weight in relation to height and was calculated by dividing patients' body mass in kilograms by their squared height in meters (kg/m^2). BMI of the patients was measured by surgeons or nurses that were involved in the hospital visits of the patients. For the analyses of the current study, two different BMI outcome types were examined. BMI change was used as the first outcome. However, because of the reliability and regression towards mean issues associated with using change scores (Kessler, 1977), no change score were calculated. Instead, postoperative BMI, controlled for preoperative BMI, was used as the first outcome variable. In addition, the percentage of excess BMI loss (%EBMIL) was used as an outcome, and calculated by the formula ((preoperative BMI – postoperative BMI) / (preoperative BMI – 25)) x 100. This variable is a measure that shows the reduction towards a healthy weight. Moreover, it allows to compare weight loss outcomes among patients.

Depression

The validated Dutch version (Bouma, Ranchor, Sanderman, & Van Sonderen, 1995) of the Center for Epidemiology Studies Depression Scale (CES-D) (Radloff, 1977) was used to measure preoperative depressive symptoms. The CES-D consists of 20 items comprising 16 feelings or behaviors on the depressive affect scale and four on the positive affect scale. Patients can indicate to what extent they have experienced these feelings or behaviors during the last week by means of a 4-point Likert scale with 0 = "never" to 3 = "all the time" (ranged 0 – 60). The Cronbach's alpha for the total score showed a good internal consistency in the preoperative sample (α = .83). An example of an item of the depressive affect scale (α = .82) was "During the past week, I felt sad". An example of an item of the positive affect scale (α = .76) was "During the past week, I was happy".

The shortened 10-item version of the CES-D (Zhang et al., 2012) (ranged 0 – 30) was used to measure postoperative depression. This shortened version appeared to be a valid and reliable tool to measure depressive symptoms and comprises the same factor structure as the original CES-D (Zhang et al., 2012). The shortened version consists of 8 items on the depressive affect (α = .835) and 2 items on the positive affect scale (α = .74). The total 10-item version had a good total internal consistency (α = .87), a good depressive affect (α = .85) and an acceptable positive affect subscale internal consistency (α = .75) in the postoperative sample.

The original 20-item CES-D was used to examine preoperative depressive symptoms as a predictor of BMI and BMI reduction. However, to examine change score after surgery, the shortened 10-item versions of both measurement points were used. The internal consistency of the 10-item preoperative survey was acceptable (α = .74) in the preoperative sample.

Self-compassion

The Self-Compassion Scale – Short Form (SCS-SF) (Raes, Pommier, Neff, & Van Gucht, 2011) was used to measure preoperative and postoperative self-compassion. The SCS-SF is a Dutch, 12-item short-form version of the original 26-item Self-Compassion Scale (SCS) (Neff, 2003). The items were answered on a 7-point Likert scale, ranged from 1 "almost never" till 7 "almost always" (ranged 12 – 84). Following the two-factor structure that was proposed by several studies (López et al., 2015), 6 items comprised the self-compassion subscale and the remaining 6 items comprised the self-criticism subscale. An example of an item of the self-compassion subscale is "I try to be understanding and patient towards those aspects of my personality I don't like". An example of an item of the self-criticism subscale is "I'm disapproving and judgmental about my own flaws and inadequacies". In the current preoperative sample, the SCS-SF had a good total internal consistency (α = .86) and good subscale self-compassion (α = .82) and subscale self-criticism (α = .87) internal consistencies. In the postoperative sample, the SCS-SF also showed good internal consistencies for the total scale (α = .88), the self-compassion subscale (α = .85) and the self-criticism subscale (α = .90).

Body image dissatisfaction

The validated Dutch version (Van Verschuer, Vrijland, Mares-Engelberts, & Klem, 2015) of the Body Image Scale (BIS) questionnaire (Hopwood, Fletcher, Lee & Ghazal, 2001) was used to measure body image dissatisfaction of the patients. The original version that has been used consists of 10-items that could be answered on a 4-point Likert scale from 0 = "not at all" to 3 = "very much". An example of an item is "Have you felt dissatisfied with your body?". One question was not applicable in the preoperative survey, since it referred to a surgery scar. This question has been removed only in the preoperative survey. In the current sample, the 9-item preoperative BIS (ranged 0 – 27) had a good internal consistency (α = .81). Also, the 10-item postoperative BIS (ranged 0 – 30) had a good internal consistency (α = .84). Because of the additional item in the postoperative survey, the mean BIS score will be used for all the analysis.

Loneliness

Emotional and social loneliness in the current study was measured with the Dutch De Jong Gierveld Loneliness scale (De Jong-Gierveld & Van Tilburg, 1999; De Jong-Gierveld & Kamphuls, 1985). Both types of loneliness were measured on a 5-point scale (yes!, yes, more or less, no, no!). An example of the emotional loneliness scale (ranged 5 – 25) was "I often feel rejected" and an example of the social loneliness scale (ranged 6 – 30) was "I miss having people around". In the current sample, good internal consistency for the 6 items of the emotional loneliness scale (α = .93) and good internal consistency on the 5 items of the social loneliness (α = .89) scale was found. The Loneliness scale has been removed in the postoperative survey, making it only possible to examine the predictive value of preoperative loneliness on preoperative BMI and short-term weight loss.

Food craving

Pre- and postoperative food craving was measured with the Dutch G-Food Craving Questionnaire-Trait (FCQ-T) questionnaire (Nijs, Franken & Muris, 2007). The FCQ-T consists of 21 items that could be answered on a 6-point Likert scale, from 1 = "never" to 6 = "all the time" (ranged 21 – 126). The four subscales that comprises FCQ-T could be defined as (1) preoccupation with food (e.g. "I feel like I have food on my mind all the time), (2) loss of control (e.g. "Once I start eating, I have trouble stopping"), (3) positive outcome expectancy (e.g. "When I eat food, I feel comforted") and (4) emotional craving (e.g. "My emotions often make me want to eat"). In the current preoperative sample, the FCQ-T had an excellent total internal consistency (α = .95). Furthermore, Cronbach's alpha for the subscales were good (α = .92; α = .90; α = .84; α = .93). FCQ-T total score of the postoperative sample also had an excellent internal consistency (α = .91) and acceptable and good internal consistencies for the subscales (α = .80; α = .82; α = .78; α = .90).

Social support

Self-reported eating- and exercise-related social support was measured by Social Support for Diet and Exercise Behaviours Scale (SSDEBS) (Sallis, Grossman, Pinski, Patterson & Nader, 1987). The SSDEBS consists of two subscales, of which the first focusses on self-reported diet support and one on self-reported exercise support. In the original scale composed by Sallis and colleagues (1987), participants were asked

to fill in the surveys twice; once aimed at self-reported family support and once aimed at self-reported friends support. In the current study, family and friend support was questioned as a combined factor. In addition, the original 8-point Likert scale was adapted to a 5-point Likert scale, in order to simplify answering for the patient group (0 = never and 4 = very often). In addition, the items of the original scale were translated into Dutch. The diet support scale consisted of 10 items, ranged from 0 to 40 with a questionable internal consistency before surgery (α = .69) and an unacceptable internal consistency in the post-surgery sample (α = .42). An example of an item was "During the last three months, my relatives encouraged me to not eat high-salt, high-fat foods when I'm tempted to do so". The exercise support scale consisted of 13 items. An example of an item of this scale was "During the last three months, my relatives gave me helpful reminders to exercise". At both preoperative and postoperative, it was found that two items negatively influenced the internal consistency. Therefore it was decided to remove these items, making the new exercise support scale comprising 11 items (ranged 0 – 44) with an excellent preoperative internal consistency (α = .92) and excellent postoperative internal consistency (α = .93).

Exercise

Exercise behaviors were measured by means of a self-report instrument (Lorig, Stewart, Ritter, Gonzalez, Laurent, & Lynch, 1996) that consisted of six items and assessed six different types of exercise behaviors; stretch and strength exercises (Exercise 1), walking as sport (e.g. Nordic walking) (Exercise 2), swimming or aquarobic (Exercise 3), cycling (Exercise 4), aerobic exercises (e.g. rowing, cross training, home trainer) (Exercise 5) and other aerobic exercises (Exercise other). The items of the instrument were initially translated into Dutch. On each of these items, patients had to fill in the amount of time that they spent on doing that type of exercise during the past week on a 5-point Likert scale (0 = none and 4 = more than 3 hours a week). According to guidelines of Lorig and colleagues (1996), items were recoded so that answers matched the number of minutes spend on exercise (0 = 0, 1 = 15, 2 = 45, 3 = 120, 4 = 180), making the total exercise scale ranged from 0 to 1080. The internal consistencies in both the preoperative (α = .22) and postoperative sample (α = .48) were unacceptable. This was perceived as logical, since different items assessed different forms of activities. Because of this unacceptable internal consistency, the individual items were also included in the analyses.

Eating self-efficacy

Self-efficacy in weight management was measured by the Weight-Efficacy Life-Style Questionnaire (WEL) (Clark, Abrams, Niaura, Eaton & Rossi, 1991), which was translated into Dutch initially. The WEL comprises 20-items that could be answered on a 10-item Likert scale (0 = 'Not at all sure' and 10 = 'Totally sure') (ranged 0 – 200). The items encompass situations in which participants estimate their self-efficacy to control eating behaviors in that particular situation. The structure of the WEL is divided in five factors representing a certain situation (Negative Emotions, Availability, Social Pressure, Physical Discomfort, and Positive Activities) with each four items. For example, an item of the Negative Emotions subscale is "I can resist eating when I am depressed or down". The Cronbach's alpha of the total WEL score of the

preoperative sample is excellent (α = .96). Also the WEL subscales had good to excellent internal consistencies in the current sample (α = .90; α = .83; α = .88; α = .82; α = .85). Due to the excessive length of the total preoperative survey, the WEL has been removed in the postoperative survey. Therefore only the predictive value of preoperative WEL scores on BMI and weight loss has been examined.

Exercise self-efficacy

Participants' self-efficacy for exercise behaviors is measured with the validated Dutch version (Nooijen, Post, Spijkerman, Bergen, Stam, & Van den Berg-Emons, 2013) of the Spinal Cord Injury Exercise Self-Efficacy Scale (SCI-ESES) (Kroll, Kehn, Ho & Groah, 2007). The SCI-ESES is a 10-item instrument that is developed to examine exercise self-efficacy in spinal cord injured patients. Items could be answered on a 4-point Likert scale that ranged from 1 = 'not at all true' to 4 = 'always true' (ranged 10 – 40). An example of an item of the scale is "I am confident that I can accomplish my physical activity and exercise goals that I set". The preoperative internal consistency in the current sample is excellent (α = .90). Due to the excessive length of the preoperative survey, the SCI-ESES has been removed in the postoperative survey as well, making it only possible to examine the predictive value on BMI and short-term weight loss.

Data analysis

Statistical analyses and data management were carried out using IBM SPSS software for Windows, version 25.0 (IBM Corp, 2017). To prevent bias due to missing item scores, total scores of the sub questionnaires and their subscales were computed by multiplying mean item scores by the number of total variable items. This method was only executed when more than half of the items were filled in, otherwise the variable was marked as missing. Prior to performing the analysis, it was determined whether variables met the distributional assumptions for the statistical tests (i.e. normality, linearity, homoscedasticity and noncollinearity). No violations of these assumptions were showed. Initially, demographic and preoperative characteristics of the sample were described using descriptive analysis. In addition, preoperative variables that were sufficient for prediction analysis ($p < .10$) were identified using Pearson bivariate correlations with BMI and BMI change measures. The predictive value of the identified predictors on preoperative BMI, postoperative BMI and excess BMI loss was examined by hierarchical multiple regression analyses, using an entry selection procedure in which gender, age and preoperative BMI were used as confounding variables. Furthermore, changes of psychological variables from pre- to post-surgery were examined using paired-sample *t* tests. Lastly, associations between changes in variables and changes in BMI were examined by conducting Pearson partial correlation analyses between postoperative variables and postoperative BMI, while controlled for age, gender, preoperative BMI and preoperative variable of interest. Significant associations ($p < .05$) were used in the hierarchical linear regression analysis on postoperative BMI. In this analysis, the preoperative variables of interest, including BMI, age and gender, were entered in Step 1 and postoperative variables of interest were entered in Step 2. This analysis examined the ability of the residuals of the variables of interest in predicting postoperative BMI. Therefore, it could be interpreted as an association between change in variables and change in BMI (Cohen, Cohen, West, & Aiken, 2003).

Results study A

Demographics

At the time of data collection for this study, a total of 190 participants signed informed consent and completed the preoperative surveys. Preoperative BMI data was missing from 11 participants. The sample that completed the six-month postoperative surveys consisted of 76 participants, and BMI data was available from 127 participants. No significant differences between participants with missing and non-missing postoperative surveys were found on BMI, age and gender. Since the BARIA study is still ongoing, the majority of the patients had not reached their six-month postoperative measuring point at the time of data collection for the current study. This accounted for the majority of the missing postoperative data. Other reasons of postoperative data missing were non-return of surveys by patients, logistical issues that prevented participants from getting the surveys on time and exclusion of participants due to converting to a different surgery method. Lastly, a few patients passed away.

The preoperative sample (n = 190) was used to describe demographic characteristics, since this sample contains all participants. Characteristics of the preoperative sample are presented in Table 1. The age of participants that entered the study ranged from 18 to 65, with an average age of 46.56 years (SD = 11.13). The majority of the sample was female (74.7%), was married or had a registered partnership (51.6%), had children (81.6%), had completed a secondary vocational education (37.9%) and was currently employed (43.7%). BMI of the surgery-awaiting patients ranged from 31.44 to 57.47, with an average BMI of 39.27 (SD = 3.73). Six months after surgery, the BMI of the current sample was reduced to a range between 23.03 and 44.41 with an average BMI of 30.25 (SD = 3.73).

Table 1.
Demographic characteristics of the preoperative sample (T0)

Characteristic	Mean (SD)	Range
Age	46.56 (11.13)	18 – 65
BMI	39.27 (3.73)	31.44 – 57.47
	Frequency (n)	**Percentage (%)**
Gender		
Female	142	74.7%
Male	48	25.3%
Marital status		
Single	34	17.9%
Married or registered partnership	98	51.6%
Cohabitated	31	16.3%
Partner but not living together	12	6.3%
Widow / widower	3	1.6%
Divorced	10	5.3%
Other	2	1.1%
Children		
Yes	155	81.6%
No	35	18.4%
Education		
Low	51	25.8%
Middle	96	50.5%
High	38	20%
Occupation		
Employed	83	43.7%
Unemployed	11	5.8%
Household	50	26.3%
Retired	1	0.5%
Voluntary work	24	12.6%
Study	9	4.7%
Incapacitated	22	11.7%

Note. Low education = no education, lower general and vocational education, secondary general education. Middle education = secondary vocational education and higher general education. High education = higher professional education and scientific education.

What are the preoperative characteristics of surgery-awaiting patients and how are they associated with preoperative BMI?

Preoperative profile of the current sample

The means and standard deviations of the total and the subscales of the preoperative (T0) variables are presented in Table 2, including the ranges of the scales. As seen in this table, the current patient group scored relatively low on depression and high on self-compassion, food craving and body image dissatisfaction. In addition, they scored on average high on eating-related and exercise-related self-efficacy, average on self-reported diet support, and low on both exercise-related support and exercise behavior. The findings regarding the bariatric profile will be discussed in further detail in the discussion.

Associations with preoperative BMI

To identify characteristics that are associated with preoperative BMI, initially, Pearson's bivariate correlation analysis was conducted. Results are also provided in Table 2. Contrary to expectations,

participants that reported higher depressive symptoms, depressive affect, body image dissatisfaction, and higher emotional and social loneliness, showed lower BMI scores. In addition, surprisingly, participants that reported more eating self-efficacy during negative emotions showed higher BMI scores.

Table 2.
Means and Pearson bivariate correlations between preoperative variables (T0) and BMI.

Variables	Mean (SD)	Range	BMI T0	BMI T1	%EBMIL
Age	46.56 (11.13)	18 – 65	-.21***	.10	-.24***
T0 BMI	39.27 (3.73)	31.44 – 57.47	-	.83***	-.57***
Gender	-	-	-.13*	-.21**	.20**
Depression					
Depression	9.22 (7.39)	0 – 60	-.17**	-.22**	.21**
Depressive affect	6.26 (5.51)	0 – 48	-.16**	-.20**	.17*
Positive affect	9.04 (2.95)	0 – 12	.13	.19**	-.22**
Self-compassion					
SC total	58.62 (13.33)	12 - 84	.06	.10	-.11
SC self-compassion	31.31 (6.70)	6 – 42	.01	.09	-.11
SC self-criticism	20.69 (9.00)	6 – 42	-.08	-.08	.08
Body image					
BI dissatisfaction	14.95 (4.19)	0 – 30	-.18**	-.25***	.21**
Loneliness					
Em. Loneliness	11.89 (4.83)	6 – 30	-.13*	-.05	-.03
Soc. Loneliness	8.79 (3.56)	5 – 25	-.17**	-.11	.03
Food craving					
FC total	59.57 (18.61)	21 – 126	-.08	.01	-.11
FC preoccupation	16.21 (6.12)	6 – 36	-.10	-.06	-.02
FC loss of control	18.18 (6.35)	6 – 36	-.08	.05	-.15*
FC pos. outcome	14.66 (4.62)	5 – 30	.05	.17*	-.23***
FC emotional craving	10.53 (4.57)	4 – 24	-.13	-.12	.05
Social support					
Support diet	25.19 (5.18)	0 – 40	.07	.04	.02
Support exercise	10.13 (8.90)	0 – 44	.02	-.01	.05
Exercise					
Exercise total	73.24 (76.45)	0 - 1080	-.11	-.14	.11
Exercise 1	20.00 (39.02)	0 – 180	-.02	-.01	-.02
Exercise 2	28.80 (42.70)	0 – 180	-.09	-.11	.09
Exercise 3	6.60 (17.30)	0 – 180	.04	-.01	.02
Exercise 4	26.96 (41.91)	0 – 180	-.11	-.14	.12
Exercise 5	11.00 (28.58)	0 – 180	.00	-.01	-.04
Exercise other	5.40 (20.73)	0 – 180	-.06	.04	-.04
Eating SE					
SE total	139.02 (37.05)	0 – 200	.12	.07	.01
SE neg. emotions	26.04 (9.26)	0 – 40	.15**	.11	-.03
SE availability	25.00 (8.21)	0 – 40	.10	.03	.06
SE social pressure	29.20 (7.84)	0 – 40	.09	.02	.02
SE phys. discomfort	29.63 (7.64)	0 – 40	.12	.08	-.03
SE pos. activities	29.14 (8.15)	0 – 40	.09	.05	.01
Exercise SE					
SE total	32.35 (5.77)	10 – 40	.02	.02	.02

Note. Gender: 1 = male, 2 = female. EBMIL: excess BMI loss; SC: self-compassion; BI: body image; FC: food craving; Exercise 1: stretch and strength; 2: walking as sport; 3: swimming or aquarobic; 4: cycling; 5: aerobic; SE: self-efficacy.
* $p < .10$. ** $p < .05$. *** $p < .01$.

Preoperative predictors of preoperative BMI

A hierarchical multiple regression analysis was conducted to identify predictors of preoperative BMI. Results of this analysis are presented below in Table 3. Age and gender were used as control variables and were therefore incorporated in the first model. The variables that associated significantly with preoperative BMI (Table 2) were used as predictors in this regression analysis. Because of the high inter-correlations between the sub and total scales of the variables (not shown in tables), only the total variables were used in the regression analyses (e.g. total WEL is used instead of the negative emotions subscale). Apart from the control variables age and gender, no more variables were identified as predictors for preoperative BMI. The model that included all variables did not significantly explain more variance than the model that only included the control variables ($\Delta R^2 = .05$; $p > .05$). Therefore, the final model included only age ($\beta = -.26$, $p = .00$) and gender ($\beta = -.19$, $p = .01$), as predictors, with a total explained variance of 7%.

Table 3.
Hierarchical regression analysis between control and preoperative variables on preoperative BMI.

Variables	**Model 1**			**Model 2**		
	B	β	p	B	β	p
Constant	46.22		.00	47.93		.00
Age	-.09	-.26	.00	-.08	-.25	.00
Gender	-1.64	-.19	.01	-1.43	-.17	.03
Depression				-.05	-.10	.29
BI dissatisfaction				-.10	-.11	.16
Social loneliness				-.21	-.20	.05
Emotional loneliness				.09	.12	.31
Eating self-efficacy				.00	.03	.70
R^2		.07			.10	
ΔR^2		.07*			.05	

N = 178.
* $p < .001$. BI: body image.

Which preoperative characteristics predict weight reduction at six-month post-surgery?

Associations with BMI reduction

Another aim of this study was to examine preoperative characteristics that are associated with short-term BMI reduction, and to identify significant predictors of post-surgical weight loss. Again, initially, Pearson's bivariate correlation analysis was conducted to identify possible predictors of BMI reduction measures. Results of this analysis are also presented in Table 2. Both postoperative BMI and percentage excess BMI loss (%EBMIL) were used as variables in the analysis. A higher postoperative BMI was associated with a higher preoperative BMI, being a male, and with lower depressive symptoms, depressive affect, and body image dissatisfaction. Participants who scored higher on the positive affect subscale of depression and the positive outcome expectancies subscale of food craving showed also higher postoperative BMI.

A younger age, being a female and a lower preoperative BMI was associated with more %EBMIL. Participants who had higher scores on the depression positive affect, food craving loss of control and food

craving positive outcome expectancies subscale had lower %EBMIL. Participants who scored higher on depression total and depressive affect subscale and body image dissatisfaction showed higher %EBMIL.

Preoperative predictors of postoperative BMI

To detect preoperative predictors BMI reduction, post-surgical BMI was controlled for preoperative BMI. Therefore, it could be interpreted as BMI reduction. Hierarchical regression analyses was conducted to identify possible predictors. Independent variables that associated significantly with BMI T0, BMI T1 or %EBMIL in the correlation analysis were included. Again, only total variable scores were used as independent variables in the analyses, due to high inter-correlations between sub and total scales. Preoperative BMI, age and gender were entered as control variables in the first model. Results presented in Table 4 show that Model 2 that included all possible predictors explained significantly more variance than the model with only the control variables ($\Delta R^2 = .03$; $p < .05$). Preoperative lower depression ($\beta = -.17$; $p = .00$), higher food craving ($\beta = .11$, $p = .04$) and more emotional loneliness ($\beta = .17$; $p = .02$) were identified as significant predictors of a higher postoperative BMI. Therefore, higher depression, lower food craving and lower emotional loneliness predicted a lower postoperative BMI, thus more BMI reduction, as it was controlled for preoperative BMI. The psychological variables in the second model explained 3% of the variance in BMI reduction.

Preoperative predictors of %EBMIL

Results of the hierarchical regression analysis on %EBMIL are also presented in Table 4. Even controlled for preoperative BMI, age and gender, higher depression ($\beta = .28$; $p = .00$), lower food craving ($\beta = -.20$; $p = .01$) and lower emotional loneliness ($\beta = -.27$; $p = .01$) emerged as significant predictors of %EBMIL. Together, the psychological variables explained 8% of the variance in %EBMIL. Model 2 explained significantly more variance than the model that only included the control variables ($\Delta R^2 = .08$; $p < .01$).

Table 4.
Hierarchical regression analysis between control and preoperative variables (T0) on postoperative BMI (T1) and %EBMIL.

	Postoperative BMI (T1)						**%EBMIL**					
	Model 1			**Model 2**			**Model 1**			**Model 2**		
Variables	B	β	p	B	β	p	B	β	p	B	β	p
(Constant)	-8.12		.00	-9.49		.00	219		.00	-234.8		.00
BMI T0	.88	.88	.00	.86	.86	.00	-3.21	-.64	.00	-3.09	-.62	.00
Age	.09	.28	.00	.09	.27	.00	-.62	-.37	.00	-.60	-.36	.00
Gender	-.29	-.03	.47	-.02	.00	.97	1.13	.03	.71	-.87	-.02	.77
Depression				-.09	-.17	.00				.70	.28	.00
BI dissatisfaction				-.06	-.07	.16				.35	.08	.28
Food craving				.02	.11	.04				-.20	-.20	.01
Social loneliness				-.03	-.03	.60				.14	.03	.78
Emotional loneliness				.13	.17	.02				-1.03	-.27	.01
Eating self-efficacy				.01	.06	.24				-.04	-.09	.28
R^2		.76			.79			.46			.54	
ΔR^2		.76***			.03*			.46***			.08**	

Note. EBMIL: excess BMI loss; BI: body image.
* $p < .05$, ** $p < .01$. *** $p < .001$.

Do these characteristics change after surgery, and are changes associated with weight loss?

Changes in variables

A paired sample t-test was used to examine changes in variables from pre to post-surgery, including thereby only the participants that completed sub questionnaires at both measurement points. Results are presented in Table 5. Means and standard deviations deviate from the results in Table 2 due to the different of numbers of participants included in the analyses. After six months, scores of participants on the depression positive affect subscale were significant higher (t = 11.55; p = .00). Although not significant, a trend towards lower depressive affect is visible. Also, a trend towards more self-compassion was found, possibly mostly explained by decreased self-criticism (t = -4.39; p = .00). In addition, self-reported food craving (and all subscales) did significantly decrease after surgery (t = -11.11; p = .00), just as body image dissatisfaction (t = -7.85; p = .00) and self-reported diet support (t = -13.15; p = .00) decreased. Lastly, patients reported more total exercise behavior after surgery (t = 3.66; p = .00). Highest increases in exercise were on stretch/strength (Exercise 1) (t = 3.62; p = .00) and aerobic exercises (Exercise 5) (t = 2.49; p = .02).

Table 5.
Paired sample t-test with pre and postoperative variables

	Preoperative	**Postoperative**			
Variables	M (SD)	M (SD)	M change	p	N
BMI	39.37 (3.87)	30.25 (3.73)	-9.12	.00	127
Depression					
Depression total	5.50 (4.50)	4.72 (5.21)	-.78	.14	75
Depressive affect	4.28 (3.73)	3.44 (3.40)	-.84	.05	75
Positive affect	1.24 (1.69)	4.70 (1.69)	3.46	.00	74
Self-compassion					
SC total	57.07 (13.14)	60.04 (13.87)	2.98	.06	72
SC self-criticism	21.56 (8.88)	17.15 (8.97)	-4.40	.00	72
SC self-compassion	30.66 (6.61)	29.50 (8.00)	-1.15	.24	74
Food craving					
FC total	59.99 (19.44)	37.39 (11.28)	-22.59	.00	74
FC preoccupation	16.16 (6.38)	10.69 (3.68)	-5.47	.00	74
FC loss of control	18.50 (6.29)	9.77 (3.45)	-8.73	.00	74
FC pos. outcome exp.	14.73 (4.73)	10.62 (4.09)	-4.11	.00	74
FC emotional craving	10.59 (4.39)	6.31 (2.83)	-4.28	.00	74
BI dissatisfaction					
BI dissatisfaction mean	1.72 (.50)	1.15 (.49)	-.57	.00	74
Social support					
Support diet	25.79 (4.79)	18.69 (3.56)	-7.10	.00	74
Support exercise	9.73 (8.76)	9.14 (9.68)	-.60	.52	73
Exercise					
Exercise total	57.60 (65.99)	98.40 (105.56)	40.80	.00	75
Exercise 1	5.80 (20.76)	20.00 (39.02)	14.20	.00	74
Exercise 2	22.09 (39.51)	29.19 (42.85)	7.10	.16	73
Exercise 3	4.66 (12.64)	6.08 (16.82)	1.42	.54	73
Exercise 4	20.47 (36.28)	26.96 (41.41)	6.49	.12	73
Exercise 5	3.45 (10.69)	11.15 (28.75)	7.70	.02	73
Exercise other	2.05 (8.27)	5.91 (22.00)	3.86	.12	65

Note. Body image score is presented as mean and depression scores are based on 10-item CES-D. SC: self-compassion; FC: food craving; BI: body image; Exercise 1: stretch and strength; 2: walking as sport; 3: swimming or aquarobic; 4: cycling; 5: aerobic.

Associations between changes in variables and BMI reduction measures

To examine whether changes in characteristics after bariatric surgery are associated with postoperative weight reduction measures, Pearson's partial correlation analysis was conducted initially. Postoperative BMI and %EBMIL were correlated with postoperative variables, whilst controlled for preoperative BMI, age, gender and the variable of interest. Results of this analysis are presented in Table 6.

Association between change in variables and BMI reduction

Higher decreases of depression total score, depressive affect, food craving total score, food craving emotional craving subscale, and body image dissatisfaction were significantly associated with lower postoperative BMI, and thus, as it was controlled for preoperative BMI, with more BMI reduction. Also, higher increases in positive affect and self-compassion scores were associated with more BMI reduction. Lastly, a higher decrease in diet support was associated with less BMI reduction.

Variables that associated significantly with BMI reduction were used as independent variables in the hierarchical regression analyses on postoperative BMI. As described in the *data analysis* section, since this analysis entered preoperative variables and control variables in the first model, and postoperative variables in the second model, it can be interpreted as examining the association between variable change and BMI change. The hierarchical regression analysis on postoperative BMI is presented in Table 7.

As visible in this table, Model 2 explained significantly more variance than Model 1 ($\Delta R^2 = .09$; $p < .001$). A higher body image dissatisfaction ($\beta = 2.09$; $p = .00$) and lower diet support ($\beta = -.13$; $p = .03$) were detected as the only significant predictors of postoperative BMI. As it was controlled for preoperative body image dissatisfaction and diet support, it can be interpreted as the following: A lower decrease of body image dissatisfaction is a significant predictor of a higher postoperative BMI, thus lower BMI reduction. In addition, more decrease in diet support is a significant predictor of higher postoperative BMI, thus lower BMI reduction.

Association between changes in variables and %EBMIL.

As seen in Table 6, more decrease in postoperative BMI was logically associated with more %EBMIL. In addition, higher decrease in depression, emotional food craving and body image dissatisfaction was also associated with higher %EBMIL. Lastly, higher increase in self-compassion, diet support, total exercise and stretch and strength exercises was associated with higher %EBMIL.

Variables that had significant correlations with %EBMIL were used as independent variables in the hierarchical regression analysis on %EBMIL. Results are also presented in Table 7. Again, because of the preoperative variables in the first model, and the postoperative variables in the second model, it will be interpreted as association between change in variables and %EBMIL. Model 2 that included the postoperative variables explained significantly more variance then Model 1 with only the control and preoperative variables ($\Delta R^2 = .13$; $p < .01$). Lower body image dissatisfaction ($\beta = -.36$; $p = .01$) was the only significant predictor of %EBMIL. As it was controlled for preoperative body image dissatisfaction, it

can be interpreted as the following: a higher decrease in body image dissatisfaction is a significant predictor of more %EBMIL.

Table 6.
Pearson partial correlations between postoperative variables (T1) and BMI measures.

Variables	BMI T1	%EBMIL
BMI T1	-	-.91***
Depression		
Depression total	.43***	-.27*
Depressive affect	.35**	-.20
Positive affect	-.27*	.14
Self-compassion		
SC total	-.29*	.17
SC self-criticism	.09	.02
SC self-compassion	-.35**	.28*
Food craving		
FC total	.26*	-.20
FC preoccupation	.24	-.19
FC loss of control	.10	-.10
FC pos. outcome exp.	.14	-.15
FC emotional craving	.39**	-.29*
Body image		
BI dissatisfaction mean	.43***	-.26*
Social support		
Support diet	-.31**	.25*
Support exercise	-.20	.10
Exercise		
Exercise total	-.19	.27*
Exercise 1	-.21	.24*
Exercise 2	-.16	.16
Exercise 3	.22	-.12
Exercise 4	-.10	.14
Exercise 5	.00	.10
Exercise other	-.18	.20

Note. Correlations are controlled for preoperative BMI, age, gender and variable of interest. EBMIL: excess BMI loss; SC: self-compassion; FC: food craving; BI: body image; Exercise 1: stretch and strength; 2: walking as sport; 3: swimming or aquarobic; 4: cycling; 5: aerobic.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 7.

Hierarchical regression analysis between change in variables on postoperative BMI and %EBMIL

	Postoperative BMI						%EBMIL					
	Model 1			Model 2			Model 1			Model 2		
Variables	B	β	p	B	β	p	B	β	p	B	β	p
(Constant)	-7,72		.07	-16.06		.00	220.06		.00	281.26		.00
T0 BMI	.86	.86	.00	.97	.97	.00	-3.09	-.62	.00	-3.95	-.79	.00
Age	.09	.27	.00	.11	.34	.00	-.58	-.34	.00	-.72	-.43	.00
Gender	-.09	-.01	.88	-.25	-.03	.59	.05	.00	.99	1.12	.03	.77
T0 Depression	-.07	-.09	.23	-.10	-.11	.13	.61	.14	.18	.27	.06	.64
T0 Self-compassion	.00	.01	.89	.05	.16	.02	-.09	-.07	.57	-.30	-.22	.07
T0 Food craving	.02	.08	.24	.02	.11	.09	-.18	-.18	.08	-.19	-.19	.08
T0 BI dissatisfaction	-.44	-.06	.44	-.40	-.05	.42	1.57	.04	.72	1.73	.04	.68
T0 Support diet	.00	.01	.93	.06	.09	.13	.14	.04	.68	.35	-.08	.41
T0 Exercise							.01	.04	.69	-.03	-.11	.28
T1 Depression				-.03	-.05	.65				.64	.18	.31
T1 Self-compassion				-.03	-.11	.18				.13	.10	.47
T1 Food craving				.03	.09	.17				-.21	-.13	.23
T1 BI dissatisfaction				2.09	.27	.00				-13.85	-.36	.01
T1 Support diet				-.13	-.13	.03				.89	.17	.09
T1 Exercise										.02	.13	.26
R^2		.77			.87			.50			.63	
ΔR^2		.77***			.09***			.50***			.13**	

Note. EBMIL: excess BMI loss; BI: body image.

* $p < .05$, ** $p < .01$. *** $p < .001$

Discussion study A

This study aimed to sketch the psychological profile of bariatric patients and the relation between psychological characteristics and weight loss. By providing participants with surveys that included a variety of questionnaires, this study is the first known study that provided an extensive, broad picture of bariatric patients after surgery. Results can be used as reference material during the development of future eHealth support interventions. The results of the present study showed quite low clinical symptomatology in the current bariatric sample. More depressive affect, lower food craving and lower emotional loneliness prior to undergoing surgery were found to predict six-month postsurgical weight loss. At this point after surgery, BMI of the participants was decreased tremendously (on average -9.12 kg/m^2), together with certain characteristics such as food craving, body image dissatisfaction and diet support. Moreover, increases in body image and increases in diet support were found to be associated with more weight loss. In the following sections, the main findings will be discussed in further detail.

Main findings

Psychological profile

The first aim of this study was to obtain a broad picture of bariatric patients, in specific regarding psychological characteristics that are known to be related with weight or weight loss. On average, it was found that the current patient group reported low on the depression scale (CES-D score of 9.92), indicating generally low depressive symptoms. However, 12% of the participants scored above the clinical cutoff score of 16 for detecting depression (Lewinsohn, Seeley, Roberts, & Allen, 1997). This percentage is somewhat higher than the 12-month prevalence of depressive disorders in the Netherlands in 2010, which was 5.2% for adults in the age of 18 – 64 (volksgezondheidenzorg.info). This implies that, despite the low general prevalence of depressive symptoms in bariatric patients in this sample, there is still a part of bariatric patients that deals with depressive feelings. Nonetheless, their self-reported depression is relatively low compared to what we expected based on studies towards obesity and depression (Luppino et al., 2010). It is possible that depressive symptoms in this patient group already decreased because they were on the waiting-list for undergoing bariatric treatment. Moreover, it could be the result of the strict selection procedure that was executed to select patients that are eligible for bariatric surgery.

Surgery-awaiting patients showed no disturbing deviations in self-compassion. The average participant indicated him/herself as quite self-compassionate, with high scores on the self-compassion subscale and middle scores on the self-criticism subscale (Raes et al., 2011). Also, following the cutoff score of 10 suggested by Hopwood and colleagues (2001), the current sample scored high on body image dissatisfaction. This was expected, since it was already known to be related with being obese (Weinberger et al., 2017). In addition, in concordance with previous studies (Leahey et al., 2012), the current patient group reported on average high food craving scores before their bariatric treatment. However, they also reported high eating-related self-efficacy, which seems to be contradictory. A

possible explanation is that patients overestimate their eating-related self-efficacy. However, no studies are available to confirm or invalidate this, making it interesting to investigate in future studies. Lastly, participants of the study reported high self-efficacy for exercise, yet the average self-reported time that patients spend on exercise was quite low. An explanation for this findings could be that questions from the current exercise self-efficacy scale were more focused on physically-related self-efficacy. For example, one item was focused on determining self-efficacy for 'being able to move without support of others'. Therefore, the current patient group presumably rated themselves as physically able to exercise, but will most likely experience other barriers to exercise. In a study of McIntosh, Hunter and Royce (2016), psychological barriers such as lack of motivation and enjoyment and stigmatization, and external barriers such as lack of time and knowledge, were found to negatively influence exercise-behavior in obese individuals.

Predictors of BMI before surgery

Another objective in this study was to identify potential predictors of preoperative BMI. Despite some associations that were found, no psychological variables were found as significant predictors of preoperative BMI. In the current sample, only the control variables age and gender predicted a higher BMI. The variance of the model was very low, indicating that this study was able to explain a minor part of the variance in BMI of surgery-awaiting patients. These results are in concordance with studies that describe the large number of causes of obesity. For example, Heitmann and colleagues (2012) described obesity as being a consequence of a mixture of genetic, environmental, cognitive, social, cultural and psychological influences. In the current sample, lower age and being a male were found as significant predictors of higher BMI before surgery. This indicates that the male participants had on average a higher preoperative BMI, and could be an indication that females sooner than males, and at a lower weight, seek for treatment of their obesity. This was also visible in the gender percentages in the current sample, showing a major overrepresentation of females (75%). These results are comparable to previous meta-analyses of bariatric surgery, in which female percentages of 79% were found (Chang, Stoll, Song, Varela, Eagon, & Colditz, 2015).

Predictors of weight reduction

This study identified several preoperative predictors of both BMI reduction and percentage of excess BMI loss (%EBMIL). Initially, a higher age and a higher preoperative BMI predicted less BMI reduction and less %EBMIL after surgery. Sillén and Anderson (2017) found similar results in their study and suggested a lower level of activity and genetic and metabolic differences in older and heavier patients as possible underlying causes. As expected, lower food craving and lower emotional loneliness predicted more BMI reduction and a higher %EBMIL at six months after surgery. This confirmed the hypothesis stated in the introduction that food craving is a negative predictor of weight loss, presumably by causing reduced adherence to diet recommendations (Sudan et al., 2017). Also, it is in concordance with previous

findings towards loneliness and weight loss after surgery. Rusch and Andris (2007) reported maladaptive eating patterns as a result of loneliness as an explanation for this reduced weight loss.

Higher depressive symptoms was found as a predictor of more BMI reduction and higher %EBMIL. These findings are similar to findings of another meta-review of Herpertz, Kielmann, Wolf, Hebebrand and Senf (2004). As a possible explanation, one study suggested that within individuals with preoperative depression, comorbid binge eating disorder is very common. Binge eating causes an expansion of the stomach, which is a major cause of the excess preoperative weight. The restricted eating capabilities due to bariatric treatment might therefore be especially effective in patients with depression and comorbid binge eating disorders (Averbukh et al., 2003). Since the current study did not include questionnaires that measured binge eating, future studies could examine this explanation further. In other studies, depression was found to inhibit patients' ability to adhere to postsurgical dietary and behavior changes on the longer term, leading to suboptimal bariatric outcomes (Herpertz et al., 2004). Another noteworthy finding is given in a study of Omalu and colleagues (2007), where an association between preoperative depression and postoperative suicide was found. These reasons emphasize the need for bariatric patients to be monitored throughout the treatment process and offered options for mental support, despite the facilitation of depression on weight reduction.

Changes of variables

The third objective of this study was to obtain insights into psychological variables that change after surgery. Besides the excessive reduction of BMI, several other psychological variables did significantly change within six months after surgery. The highest changes were visible in food craving and its subscales. After six months, participants of the current study experienced tremendously lower food craving in general and during all kind of specific situations (e.g. during emotional situations). This finding is in concordance with a previous study towards six-month effects of bariatric surgery (Leahey et al., 2012) and is considered a logical consequence of bariatric treatment. Especially this short after surgery, patients are not able to eat as they did before, in order to not experience dumping-related symptoms. However, the longer after surgery, the more patients are able to eat again (Sjöström et al., 2004). To examine whether this will be accompanied with increased food cravings again, it is interesting to investigate changes in food craving over the longer term.

Body image dissatisfaction was also significant lower at the postoperative measurement point. Moreover, it was found that the more body image was decreased, the more weight was lost. Again, this corresponded to the hypothesis and showed that patients were fortunately more satisfied with their body after they lost weight. In contrast, despite the high average weight loss and improved body image satisfaction, depressive symptoms were not significantly reduced. This contrasted with findings of a longitudinal study of Booth and colleagues (2015). They found, especially at their one-year postoperative measurement point, average improvement of depressive affect as a consequence of weight loss. Differences in postoperative measurement points (six months vs one year) could explain the

different findings. In addition, the participants in the current sample initially already showed low depressive symptoms in general, which could also be an explanation for this non-significant change.

Before surgery, patients reported that they received low exercise-related support, which remained so six months after surgery. However, self-reported exercise behavior did significantly improve after surgery, presumably due to increased physical fitness. In addition, diet-related support that was found before surgery was average, yet it was reduced after surgery. Presumably, already after six months, family and friends of bariatric patients provided substantial less diet support. This is a worrying finding that is more often visible after other types of surgery (Neuling & Winefield, 1988). It is interesting to examine whether this decrease is a consequence of a lower need for diet support by the patients, or a lower motivation to provide support by friends and family themselves. The current study also found that the higher the decline of perceived diet support, the lesser weight was lost. This finding is in line with the growing body of literature that show the impact of social support on health. Social support earlier had been shown to promote adherence to diet regimens (Magrin et al., 2015). Apparently, it is important that close ones of bariatric patients need to stay focused on providing support. Future bariatric interventions should target and mobilize social support after surgery.

Limitations and further research

Future research need to take limitations of the current study into account. First, the small sample size of the postoperative measurement point of the current study limited the power of some analyses that were conducted. Moreover, the current postoperative measurement point was possibly too early to detect the psychological variables that influence weight loss. Bariatric surgery has a superior effectiveness that, especially on the short-term, causes nearly everyone to lose weight. The biggest challenge is to maintain this weight over a longer period of time, since unhealthy eating and lifestyle habits might re-emerge longer after surgery (McGrice & Don Paul, 2015). After this short-term initial effect of surgery, variations in psychological variables will start to become a bigger influence on who succeeds to maintain weight loss. As mentioned earlier, this study is a preliminary study of an ongoing project. In the future, this project will benefit from increased sample sizes and later postoperative measurement points. Nonetheless, to arrange support of bariatric patients shortly after surgery, it is also important to examine short-term outcomes. This study have led to important insights into characteristics or groups of patients that are struggle with weight loss and are in need for additional support.

Other limitations of the current study were focused on the psychological variables that were questioned in the baseline and follow-up surveys. First, because this study was conducted as part of the larger BARIA study, the variables included in the surveys were already determined. It would have been interesting to also include important determinants of behavior change theories described in the introduction, such as motivation, perceived behavioral control and the stages of the Transtheoretical Model. Second, in order to shorten the postoperative measurement point, some sub questionnaires had to be removed. Therefore, among others, self-efficacy and loneliness questionnaires were removed from

this survey. It would have been interesting to examine whether changes in weight were related with decrease of loneliness and increase of eating-related self-efficacy. These insights would have especially benefit the development of a future eHealth support intervention, since both self-efficacy and loneliness are factors that have the potential to be targeted by such an online intervention.

Some questionnaires that were used in the pre- and postsurgical surveys have been translated into Dutch for the purposes of this study, and were therefore not validated. The non-validated version can be perceived as a limitation in the current study. In addition, it was interesting to note the increase of exercise, however, the current self-reported exercise scale that was used had a low internal consistency. Moreover, self-reported physical activity measures previously appeared to be no reliable measures for exercise. One systematic review that compared self-report with direct measures found low correlations (Prince, Adamo, Hamel, Hardt, Gorber, & Tremblay, 2008). Future research that will investigate the role of exercise on postsurgical weight loss should increase reliability by using more objective measures, such as pedometers.

Lastly, associations between different psychological characteristics were not extensively investigated in this study. However, in the future, it would be interesting to examining relations between these variables. For example, does depression predict more food craving during emotional moments? Or is higher body image dissatisfaction associated with more emotional or social loneliness? And how is the association between eating-related self-efficacy and food craving? The high amount of data that will be collected during the BARIA project allows many questions to be investigated. These insights will provide an extensive picture of the bariatric patient group.

Method study B

Study design

A qualitative research design was chosen to examine the research questions of the second part of this study. Semi-structured interviews with bariatric patients, a nurse practitioner and a dietician have been held to identify current problems and barriers after surgery, general needs regarding a future eHealth intervention and specific needs regarding the usefulness of the features of VitalinQ. Qualitative studies that focus on user experiences help researchers understand how a system should be further developed and improved to match needs of end users (Kulyk, op den Akker, Klaassen, van Gemert-Pijnen 2014). Moreover, qualitative research can result in insights into active ingredients of interventions and reasons for success or failure of interventions (Lewis, Glenton & Oxman, 2009; Campbell, Fitzpatrick, Haines & Kinmonth, 2000). Prior to the study, the Ethics Committee of the University of Twente (Behavioural, Management, and Social Sciences) did assess whether the study conforms ethical standards and provided ethical approval for this study. The study was conducted according to the World Medical Association (WMA) Declaration of Helsinki principles.

Participants

Bariatric patients that participated the current study were recruited from bariatric surgery departments from the Medical Center (MC) Slotervaart and the Medical Center Leeuwarden (MCL), both medical hospitals in the Netherlands that are specialized in bariatric procedures. Semi-structured interviews have been held with six patients from MC Slotervaart and five patients from MCL, making it a total of 11 participants. First, to be eligible for bariatric surgery, patients had to meet the bariatric surgery guidelines that were mentioned in the method of study A. Second, in order to participate the present study, patients must (1) give informed consent, (2) have undergone bariatric surgery at MC Slotervaart or MCL and (3) own and use a smartphone with internet connection. Non-Dutch speaking patients and patients that never prepare their own meals were excluded from this study. Expert insights were obtained by conducting semi-structured interviews with a dietician and a nurse practitioner, both involved in the aftercare of patients who underwent bariatric surgery at MC Slotervaart.

Procedure

This second part of the study consisted of two sub rounds with different interview schemes. In both sub rounds, an existing healthy lifestyle support eHealth application (VitalinQ) has been used to show, explain and provide to participants. A more extensive description of VitalinQ is given in the *Description of VitalinQ* section.

In the first sub round, semi-structured interviews with five bariatric patients (further referred to as A-participants), a nurse practitioner and a dietician have been held to identify current post-surgery problems, needs and preferences regarding a future eHealth application. Patients of MC Slotervaart that had a hospital appointment on April 10th 2018 were contacted by telephone by a medical internist.

During this phone call, the goal of the study was shortly explained and patients were asked for permission to be approached by the researcher after their hospital appointment. When approved, the researchers explained the goal and method of the interview after their follow-up hospital appointment at MC Slotervaart. Patients that would like to participate were provided with an information letter and informed consent and permission was obtained to audio record the interview. Patients were informed that participation was voluntary, that answers were stored and processed anonymously and that they could quit any time during and after the interview. They received no compensation for participation. After the patients had given their informed consent, they were interviewed. The dietician and nurse practitioner from MC Slotervaart were recruited by e-mail. All interviews were audio-recorded and transcribed verbatim. The average interview lasted 21 minutes.

During the second round, bariatric patients were provided with the VitalinQ application for a testing period of 14 days. Participants in this second round will be further referred to as B-participants. Bariatric patients were recruited from both MC Slotervaart and MCL. Patients that had a six-month or one-year follow-up hospital meeting at MC Slotervaart on June 5th 2018 were contacted by telephone by a medical internist. During this phone call, patients were asked for permission to be approached by the researcher after their hospital appointment. When approved, the researcher of the current study explained the goal and method of the study to the patients, after which they decided whether they wanted to participate. Patients from MCL were recruited during follow-up group meetings that were part of the regular bariatric aftercare and were arranged on June 28th 2018. At the start of these meetings, the goal and method of the current study was explained to the patients, after which they decided whether they wanted to participate the study. Three patients of MC Slotervaart and six patients of MCL were interested and were provided with an information letter, informed consent and a manual of the VitalinQ application (see Appendix A). Participants were informed that participation was voluntary, that they could quit participation at any time during the test period and the interview and that answered on the interview were stored and processes anonymously. After provision of informed consent, the VitalinQ application was explained by going through the application and the manual together. In addition, premium login credentials were given and the telephonic interviews were scheduled. Participants were asked to download VitalinQ and to use and explore the application during a period of 14 days. In addition, they were asked to carry out some small assignments that were related to the use of the application (e.g. "Try out one or more recipes of the application"). After the testing period, telephonic interviews with the participants were held. All telephonic interviews were audio-recorded and transcribed verbatim, with the prior permission of the participants.

Interview schemes

The semi-structured interviews that were used for the A-participants of the *first round* were developed based on research questions of the current study and on features of the VitalinQ application. Specifically, patients were asked about demographics, nutrition, problems and barriers, need for (application)

support, eHealth use and needs regarding an eHealth application. Experts were asked about nutrition, problems and barriers, current support and needs regarding a future eHealth application. In addition, the application VitalinQ has been showed and explained to both the patients and the experts. Participants were told to comment on the application and its features during this explanation. Also, several semi-structured interview questions regarding usefulness of features, general impression and missing or unnecessary parts were prepared at forehand. The interview scheme of the patients is supplemented in Appendix B. In addition, the interview scheme of the professionals is supplemented in Appendix C.

For the B-participants of the *second round* of this study, a semi-structured interview guide was developed based on the research questions and features of the VitalinQ application. Furthermore, several articles have been conducted to determine questions about feasibility, user-experiences, usability and general attitudes against eHealth (Sousa & Dunn Lopez, 2017; Dobson & Hall, 2015; Kulyk et al., 2014). Specifically, interview topics contained general impression, appearance, usability and learning effects of VitalinQ, questions about current features or preferred features in a future application and questions about future use of the application. Patients were encouraged to motivate their answers and experiences with the use of the application. Patients were asked to rate some aspect on a 10-point Likert scale. Lastly, the Net Promotor Score (NPS) was asked to determine satisfaction with the question: 'How likely is it that you would recommend VitalinQ to other bariatric patients?' (10-point Likert scale from 0 = not likely to 10 = very likely). The NPS was calculated by subtracting the percentage of detractors (score 6 and lower) from the percentage of promoters (score 9 and 10) (Reichheld & Markey, 2011). The final NPS score can range between -100 and +100, with a positive score considered as good. The final semi-structured interview is supplemented in Appendix D.

Description of VitalinQ

VitalinQ is an eHealth platform that supports users in obtaining a healthy lifestyle. It aims to increase awareness of users about effects and influences of nutrition and exercise. It provides daily varying tips and information about healthy lifestyle behaviors and contains several functions in the area of nutrition and exercise. In the VitalinQ application, users can self-monitoring food and drinks in a food diary. The current food diary function of VitalinQ contains six fixed eating moments (breakfast, in between snack, lunch, in between snack, diner and evening snack), in which meals and drinks could be entered. At the end of the day, users can view their nutritional values of their daily meals, including personalized advice on nutrient deficiencies and nutrient excesses. Another option of the application is that it provides the user with several healthy and varied recipes per fixed eating moment, including ingredients, method of preparation and preparation difficulty. Unique to the application is its personalized content. Recipes and nutritional advices are based on medical data that can be entered by the user, such as weight, age or blood pressure, and also lifestyle-related disorders such as diabetes, hypertension or irritable bower disorder. Moreover, the application takes allergies and lifestyle preferences (e.g. being a vegetarian) into

account. Another feature of VitalinQ is the opportunity to set personal nutritional or exercise challenges. The application contains four fixed challenges; “Drink a daily amount of 2000 ml fluid for a week”, “Walk a daily amount of 10.000 steps for a week”, “Eat a daily amount of 200 grams of fruit for a week” and “Eat a daily amount of 250 grams of vegetables for a week”. To keep track of the step challenge, other devices or applications can be connected to VitalinQ. A Dutch manual that has been provided to participants of the current study can be find in Appendix A. Screenshots of several functions of VitalinQ are presented in Figure 2.

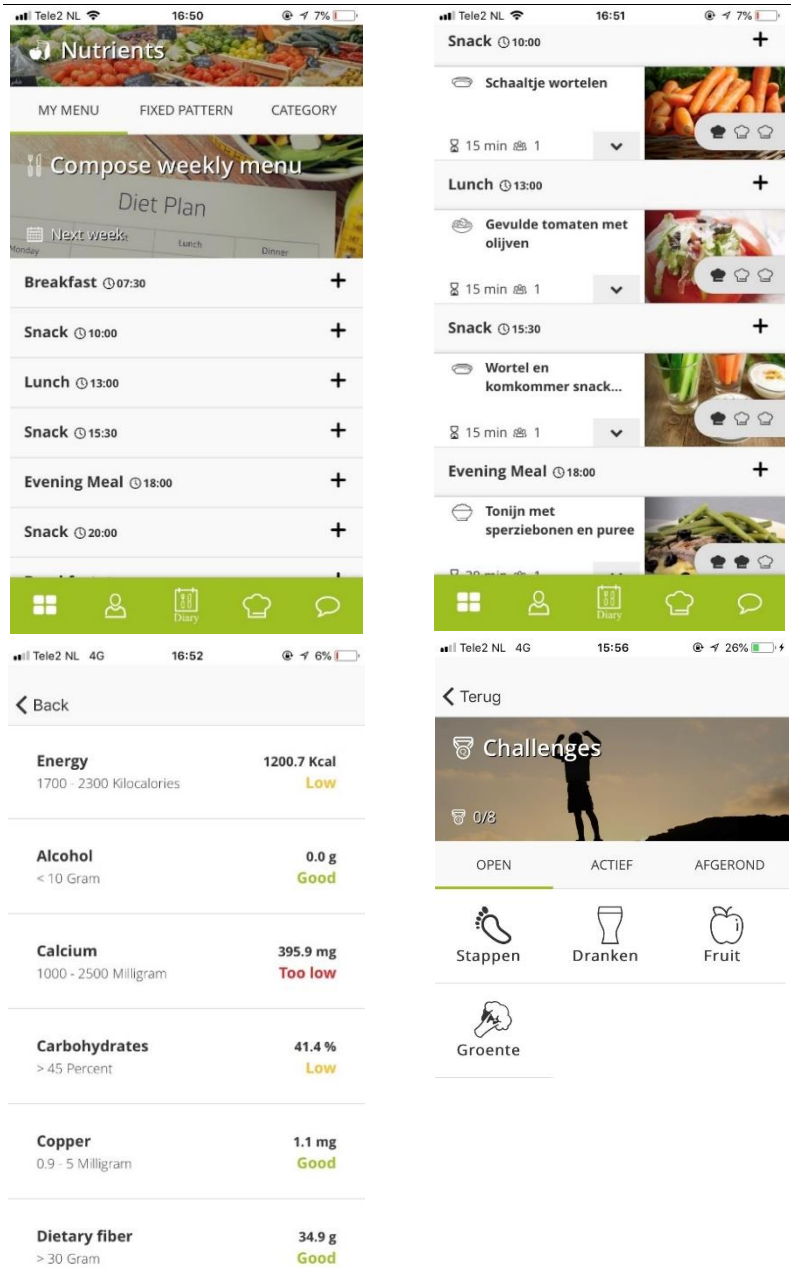

Figure 2: Screenshots of VitalinQ

Data analysis

Analyses

All interviews were transcribed verbatim and additional data analyses were carried out to identify patterns in responses of participants, using both inductive and deductive thematic analyses (Braun & Clarke, 2006). Initially, transcripts were reread to familiarize with the content. Subsequently, inductive analysis was used to identify reported problems and barriers of bariatric patients. In addition, deductive analysis with predefined themes (i.e. general impression, attitudes to eHealth, usability, appearance, recipes, food diary, challenges) was used to identify user-experiences of the VitalinQ application and its features. For the final part of this study, inductive analysis was used to determine further needs and preferences for a future eHealth application. Responses of participants were summarized, quantified where possible and processed in tables.

Generating user-requirements

Based on outcomes of the inductive and deductive analyses, user-requirements for a future eHealth intervention were created. User-expressions that captured the same issue were translated into values, which are needs and wishes that key stakeholders deem important related to goals and functions of eHealth interventions (van Gemert-Pijnen et al., 2011). Afterwards, values were generated into user-requirements. Issues were translated into requirements when they were described frequently or when they capture something that is important for the goal of the intervention. An example of the generation from a user-expression towards a user-requirement is provided in Table 8.

Table 8.
Generation of user-requirements

User-expression	**Value**	**User-requirement**
B5: *"Dat je dan bijvoorbeeld, u heeft te weinig eiwitten, dat je dan onder eiwitten kan zoeken wat je dan nog het best kan eten om dit aan te vullen".*	Personalized tips in nutritional feedback	The app provides informative nutritional feedback including tailored tips and recipes regarding dealing with nutrient deficits
A5: "*Dan zou eigenlijk het systeem moeten zeggen: "varieer eens". [...] als je elke keer hetzelfde eet, dat je in ieder geval de tip krijgt om te variëren".*		

Results study B

The results from the semi-structured interviews in Study B are presented in this section. This section starts with the demographic characteristics of the interviewed sample. It continues with the emerging problems and barriers that patients experience after bariatric surgery. Subsequently, it provides the results of the evaluation of VitalinQ and suggestions for improvement of the application. In addition, other needs and preferences regarding a future eHealth support intervention that were given by both patients and experts will be presented. Finally, this results section ends with user-requirements that were composed based on results of interviews with patients and experts.

Demographics

Five bariatric patients signed informed consent and participated the first interview round (A-participants), together with one nurse practitioner and one dietician. In addition, nine bariatric patients signed informed consent and were provided with VitalinQ in the second round (B-participants). Two patients no longer wanted to participate due to illness and one patient could no longer be reached. The characteristics of the remaining 11 patients that participated the interviews are listed in Table 10. The vast majority of the participants was female (82%), was married or cohabitated with a partner (55%) completed middle-level education (73%) and was currently full or part-time employed (55%). The dietician and nurse practitioner worked for three and five years respectively in their current position.

Table 10.
Demographic characteristics

Characteristics	**Mean**	**Range**
Age	47	34 - 61
Gender	**Frequency (N)**	**Percentage (%)**
Female	9	82%
Male	2	18%
Marital status		
Single	3	27%
Married or cohabitated with partner	6	55%
Divorced	2	18%
Education		
Low	2	18%
Middle	8	73%
High	1	9%
Employment		
Employed (full and part-time)	6	55%
Unemployed	5	45%

Total N = 11

What are problems and barriers after bariatric surgery?

Several problems emerged from the interviews that were held with bariatric patients and professionals. The problems that participants mentioned were subdivided in eating-related, drinking-related and

psychosocial problems. An overview of the problems, including the number of participants that mentioned it, are provided in Table 11.

Eating-related problems

Some participants indicated that they did not experience many problems with adapting to new dietary lifestyle behaviors. They gave as a reason that in the year prior to the surgery, they already had to adapt their eating and drinking behaviors. For example, they were supported by dieticians in limiting the maximum number of meals per day to six meals and they had to separate their drinking and eating moments already. *"Nou ja dat hadden we daarvoor al moeten doen he, dat is dat hele voortraject. En dan ga je al naar zes keer per dag eten, je gaat je drinken al scheiden van je eten, dus dat zat er eigenlijk al goed in doordat ik dat van tevoren al goed heb gedaan* (B3)*".*

Adherence to recommended eating standards

What did emerge from the interviews was that many participants are often unable to adhere to the six recommended eating moments a day. Most participants claim that they often forget to eat, due to not experiencing feelings of hunger. This could lead to malnutrition. "*Ja je eten. Dat moeten eten, want je hebt eigenlijk geen honger. Ik probeer toch wel zes keer per dag te eten, maar daar moet je heel erg aan denken. Je bent heel snel geneigd om het te vergeten omdat je gewoon geen honger hebt* (B4)*".* This problem was also confirmed by the dietician, who described that the general picture after surgery is that the majority of patients sooner have too little, rather than too much eating moments a day. "*Ze vinden het vaak moeilijk om zich toch aan zes eetmomenten te houden. Ze hebben vaak eerder te weinig eetmomenten dan te veel, dat is het algemene beeld. Ze hebben moeite om zich aan die regelmaat te houden […] Het honger/trek gevoel is vaak in het begin minder. Of soms zelfs weg. Dus om dan toch zes keer te gaan eten is best een opgave* (D)". As a result of these lacking eating moments or reduced food intake, nutrient deficits emerge as a frequently occurring problem, causing tiredness and lack of energy. "*Waarschijnlijk door tekorten. Ik ben moe als ik op sta en als ik naar bed ga. Dus niet moe dat ik moet slapen, maar gewoon een heel moe gevoel* (B4)".

Dumping syndrome and food intolerance

Some patients mentioned symptoms of dumping syndrome as a problem after surgery. As described earlier, dumping syndrome include symptoms such nausea, abdominal cramps, diarrhea, sweating, dizziness and palpitations (Ukleja, 2005). "*Ik vind het lastig dat je niet alles kan eten in het begin, dan krijg je een dumping zoals dat heet. En die zijn niet leuk. Ik heb hier nog steeds last van* (A2)". A dumping can occur as a result of overeating or eating too much sugar, yet also as a result of eating fruit sugars. "*Het kan ook van een roomsoesje en die kan je in 1 keer in je mond stoppen. Maar het kan dus ook van een hele hoop fruitsuikers in een kleine hoeveelheid bijvoorbeeld in een smoothie. Die je dan in 1 keer opdrinkt. En dan poef, dumping* (N)". In addition, a group of patients mentioned troubles with the digestion and tolerance of certain foods after surgery. Specific foods, which differs among patients, suddenly cause physical discomfort that is related with dumping syndrome. As a result of anxiety for

dumping symptoms, one patient mentioned being anxious in trying new products: "*daarna is het heel eng om weer gewoon te gaan eten. De helft gaat niet en de andere helft eigenlijk ook niet* (B6)".

Protein intake

Most participants reported difficulties with the intake of sufficient proteins from their meals. "*Ja, eiwitten eet ik te weinig* (A2)*", "De eiwitten, dat is heel moeilijk want dat lees je nergens he. Nou ja, wel op de verpakking, maar ja* (A4)*".* They mentioned a strong emphasize on sufficient protein intake after bariatric surgery, which is even more important than the intake of fruit and vegetables. *"Op zich, je hebt de groente wel nodig. Maar voor ons is de keus tussen eiwitten en groente gaat toch vaak naar eiwitten, want dat wordt ook aangeraden. Eerst de eiwitten, en daarna zit je vaak vol (B4)".* The dietician explained this emphasis, by explaining that patients need the same amount of protein as building blocks for their body, as they did before, yet from a much smaller portion of food due to the food restricting outcome of bariatric surgery. Moreover, protein deficiency cannot be reduced by vitamin pills. "*Ja, het kost de meeste patiënten moeite om de eiwitbehoefte te halen, dus vandaar dat we daar de nadruk op leggen. Eiwitten heb je nodig in je voeding, het zijn de bouwstoffen. Mensen kunnen veel minder eten, maar blijven toch dezelfde hoeveelheid eiwitten nodig hebben. En eiwitten kunnen niet in vitaminepillen worden verwerkt, dus ja, dit vinden ze vaak lastig* (D)*".*

Not knowing what to eat

As a result of the emphasis on proteins, patients reported difficulties with preparing varying meals. They indicated that meals often are unvaried, because otherwise they will not meet their recommended protein requirements. *"We eten altijd hetzelfde, maar we willen eens wat anders* (B4)". For example, one participant mentioned that she always eats yoghurt for breakfast, since this contains a large amount of proteins: "*Avondeten varieer je natuurlijk in maar ontbijt is zo makkelijk om dat elke dag hetzelfde te doen. En dan doe ik het wel, want dan denk ik, mijn lichaam wil af en toe wat anders. En dan neem ik een boterham om gek te doen 's ochtends, alleen dan denk ik, wanneer doe ik dan mijn yoghurt moment, en dan raak ik helemaal in paniek eigenlijk [...] Ja ik moet mijn eiwit hebben. En dat is dus lastig, want dan wil je dus een boterham. Maar ik moét eiwit, dus dan neem ik een boterham met kaas maar ik moet eigenlijk nog meer eiwit. Dus dan neem ik karnemelk, maar dat mag ik dan weer niet met mijn boterham eten. Dus dat is het lastige aan die operatie* (A4)*".*

Not knowing what to eat in the liquid period (the two weeks after the surgery during which patients cannot eat solid food), was specifically mentioned by three participants. "*Eh, je wordt eigenlijk de wei ingestuurd [...] zeker de vloeibare periode, dat is gewoon heel smerig om voedsel te pureren, dus daar werd ik niet… ik had daar echt wel meer informatie gewild* (A4)*". "Ja, nu je dat zegt over die recepten. Dat miste ik in die vloeibare periode, dat vond ik de vreselijke periode. [...] Daar had ik heel erg van oh wat moet ik nou weer pureren, hoe doe ik dit, bah, wat gaat daar doorheen* (A3)*".*

Table 11
Problems and barriers after bariatric surgery

Category	Specific problems	N	Participants
Eating-related	Malnutrition, leading to nutrient deficits	6	A5, B1, B4, B5, B6, D
	Eating too much, resulting in dumping	4	A1, A2, N, D
	Difficulties with sufficient protein intake	7	A1, A2, A4, B1, B6, D, N
	Not knowing what to eat	6	A1, A4, A5, B4, B5, B6
	Not knowing what to eat in liquid period	3	A3, A4, B6
	Not able to tolerate certain foods	4	A2, A5, B5, B6
Drinking-related	Separate eating and drinking moments	7	A1, A3, A4, B4, B5, B6, D
	Not drinking enough	8	A3, A4, A5, B3, B4, B5, B6, D
Psychosocial	Missing comfort eating	1	B4
	Fear to gain weight again	1	B5
	Negative reactions	1	N

Note. A-patients participated the first interview round, B-patients participated the second interview round. N = nurse. D = dietician. Total N = 13.

Drinking-related problems

Separate eating and drinking moments and drinking too little

Drinking-related problems that emerged from the interviews were related to no longer being able to eat and drink at the same time: "*Het lastigst vond ik dat je niet meer kan eten en drinken tegelijk* (A1)*"*. After bariatric surgery, patients need to separate their meals and drinks and are no longer allowed to drink within half an hour before and after eating something. Why this is recommended was explained by the nurse, who explained that fluid push food down the digestive track at a quicker rate, allowing patients to eat more, and therefore most likely decrease less weight. "*Dus mensen die eten en drinken tegelijk met name eerst eten en dan drinken, die, dat eten dat zakt sneller door, waardoor ze weer eerder meer kunnen eten, en sneller achter elkaar kunnen eten, en dan dus ook meer calorieën gaan binnenkrijgen waardoor je gewichtstoename ziet* (N)". However, many patients reported difficulties with getting used to this new dietary recommendation. For example, one participant mentioned that she missed drinking and eating at the same time, especially during eating spicy meals. *"Dit had ik niet verwacht van tevoren, het is gewoon zo'n gewoonte. Zeker als je pittig eet enzo. Dat is echt, dat mis ik gewoon echt heel erg* (A3)*"*.

As a result, the majority of the patients mentioned difficulties with drinking the recommended daily amount of liquid. Thanks to the separation of drinks and food, patients often forget to drink and therefore do not drink enough fluid in a day: "*Doordat eten en drinken niet samen kan vergeet je te drinken, dus ik drink te weinig. Nu moet je eerst een half uur wachten. En dan is het een half uur later en dan ben ik andere dingen aan het doen en dan drink ik niet meer* (A4)", "*Nou ja dat je denkt oh ik ga nu drinken. Oh ik moet eigenlijk ook wel weer eten. Dus dat vond ik lastig* (A3)".

Psychosocial problems

Missing comfort eating

Only two participants pointed out problems on a psychological level. One participant mentioned that she sometimes missed food as a 'comfort friend' during difficult, emotional days. "*En ja, de*

bijkomstigheid van niks kunnen eten dat komt erbij. En de ene keer gaat dat goed en de andere dagen kan het wat minder gaan. Als er bijvoorbeeld iets is waardoor de dag wat minder gaat, dan mis ik mijn vriendje eten wel. Normaal gesproken zou ik dan gaan eten, als troost, maar nu kan dat niet meer en nu moet ik iets anders verzinnen (B4)".

Fear to gain weight again

Another participant expressed feelings of fear, insecurity and anxiety during a period that her weight did not drop anymore. She expressed fear to relapse to an old eating pattern and to gain weight again: "*wat ik heb gehad is dat ik in het begin natuurlijk heel mooi af ging vallen. Dus dat ging goed. En ik heb een poos op een plateau gestaan. En toen werd ik wel heel erg bang, zo van wow, wat doe ik nu verkeerd. En waarom val ik niet meer af. En toen werd ik heel onzeker. En toen werd ik ook wel weer bang om te gaan groeien weer, en ook dat ik terug zou vallen in een oud eetpatroon. Dat vond ik wel heel spannend, ja* (B5)".

Negative reactions

No more problems on a psychological or social level were revealed from the interviews with the patients. However, the nurse practitioner pointed out some issues that patients experience frequently on a psychosocial level. Initially, she mentioned that within many patients, their body reduces weight faster than their mental state can get used to. As a result, they still feel the same person as they were before, however people around them do treat them a lot differently after losing this weight. In a positive way, through an increase in invitations for social events, yet also in a negative way, through negative comments (e.g. "everyone can lose weight with such an operation, you have chosen the easy way"). *"En psychische problemen. Je lichaam valt sneller af dan dat je mentale toestand daaraan kan wennen. Dus je bent al 30 kilo lichter en mensen van buitenaf vinden daar van alles van. Alleen jij voelt je nog steeds die 130 kilo die je was voor de operatie, je bent niet een ander mens geworden, maar mensen behandelen je wel als een ander mens, opeens word je wel uitgenodigd voor de borrels of uitjes.* […] *Ja nou ja soms is het positiever en soms is het ook negatief. He mensen zeggen iedereen kan afvallen als je zo'n operatie hebt gehad, je hebt de makkelijke weg gekozen. Of nou je bent nu zeker wel een beetje doorgeslagen, je hebt nou zeker anorexia ofzo* (N)*"*. In addition, she mentioned that many patients before they had their srugery have always acted very restrained during conflicts, because of fear to get comments on their weight. The moment this obesity reduces, they become more assertive. As a result, they obtain accusations into changing in a mean person "well, since you have lost weight, you suddenly have become much more unkind". "*Of ze hebben zich altijd door hun overgewicht altijd heel erg ingehouden en op de achtergrond gezet, dan dachten ze van nou he in een conflict hou ik mijn mond wel want stel dat ik een opmerking over mijn overgewicht krijg. Dan durven ze voor hun operatie daar niet zoveel van te zeggen maar op het moment dat dat overgewicht weg valt worden ze assertiever. Waardoor er mensen gaan zeggen van nou sinds je afgevallen bent ben je wel ineens veel onaardiger geworden hoor. Dus mensen vinden altijd wel een manier, dat hoeft niet altijd positief te zijn* (N)*"*.

What are the user-experiences of VitalinQ and what are other needs and preferences regarding an eHealth intervention?

In this section, the outcomes of the evaluation questions about VitalinQ and its comprising functions, suggestions for improvement of functions and other needs and wishes that emerge from the interviews will be described. The results of the interviews with both A and B-participants will be used combined. However, only the B-participants from the second interview round, who had used the application for a test period of 14 days (N = 6) were asked about usability of the application and were asked to grade VitalinQ. Therefore these outcomes are only based on interviews with B-participants. This section will be subdivided in the general impression of VitalinQ, usability evaluation, appearance evaluation and evaluation of different functions of the application. In addition, suggestions for improvement of functions and other needs and preferences that stakeholders deem important are provided in every sub section. This section will finish with establishing user-requirements for an eHealth support intervention, which will be provided in Table 12.

General impression

There was a substantial difference concerning the general impression of VitalinQ between both sub groups. A-participants were all very positive about VitalinQ, after the application and its comprising functions was explained. Patients mentioned that the application matched exactly what they were looking for: "I*k zei net al, ik zoek een app voor eten ondersteuning, ja dan is dit wel echt goed* (A1)", that they would like to use the application immediately: "*Ja geweldig, ik wil het wel. Graag, schrijf maar even op* (A3)", and that they liked the fact that the application gives advices for meals and recipes: "*Top vind ik, die maaltijden zijn vooral echt top* (A5)*"*. In contrast, B-participants were less positive towards the application. The overall impression of the current was graded by this sub group with a 6 (scale 0 – 10). Patients were relatively positive about its focus on eating and healthy recipes. Also, patients mentioned that they were initially, during the explanation of the application, very enthusiastic about the application. However, this positivity was dominated by the lack of ease of use of VitalinQ ("*Ja, terwijl, ik was juist ook wel erg enthousiast toen je erover vertelde. Ik dacht oh wat leuk, het geeft recepten, je kan er zelf recepten in zetten, je kan er je waarden mee bijhouden. Dus ik was erg enthousiast, maar het gebruik ervan was moeilijk. Het is me niet gelukt om zelf recepten toe te voegen bijvoorbeeld. Dat heb ik niet gevonden. Als ik het probeerde dan was het hup, weg recept* (B3)"), and the lack of bariatric-focused possibilities ("*nou het concept is echt goed, dus dan zou ik het een 8 geven. Maar ja voor de bariatrie is dit nog niet echt van toepassing, daar is het nog te algemeen voor* (B6)").

The Net Promotor Score (NPS) was used to assess the probability that participants would recommend the current application to a fellow bariatric patient. All participants were not very likely to recommend the current application, with an average score of 3.2 (scale 0 – 10), and a NPS of -100, indicating bad satisfaction. However, when patients were asked to grade the likelihood to recommend the concept of VitalinQ, yet when it will be completely adapted to bariatric standards, this grade rose tremendously towards an average score of 8.4 and a NPS of +100.

Usability

The reported usability of VitalinQ was rated relatively low by the B-participants, with an average score of 5.8. Two participants graded the application with a 7 and reported no major difficulties with using the application and its menu during the testing period. "*ja daar was eigenlijk weinig mis mee. Je kon heel mooi op het menu drukken en dan kon je dingen invoeren* (B4)". Another participant mentioned that she found the application clear and structured. However, due to technical issues (application closed itself frequently), she was not able to use the application properly: "*Ik vind hem heel overzichtelijk en duidelijk. Het is niet zo dat je moet puzzelen enzo. Maar ja, hij valt steeds weg* (B5)". The rest of the participants were less positive towards the usability. Reasons that were given comprised lacking a logical structure ("I*k denk dat ik het 20 keer geprobeerd heb, en 20 keer dacht ik na 10 minuten van nou ik stop er mee".* I: *"Waar lag dat dan aan? B: Er is totaal geen gebruikersgemak, het is heel onlogisch opgebouwd* (B1)"), difficulties with finding different functions ("*Nou ik vond het voor mezelf een beetje onduidelijk. Ik moest veel zoeken, ik ben niet zo heel handig met telefoons en met apps* (B2)*"*), the prevalence of too many technical issues ("*En dan wil ik wat aanklikken en ineens is het weg. En dan denk ik nou waar is het nou gebleven. En dan ga ik terug maar dan vind ik het niet* (B4)"), and a lack of possibilities regarding entering food into the eating diary, which will be explained further in the *evaluation of different functions* section.

Some participants gave suggestions for improving the usability of the app. The use of a pre menu that include clear buttons for the most important functions was mentioned by two participants: "*Ik zou een startmenu anders indelen. Zoals met buttons. Een startpagina met zes of acht buttons. Als je daarop drukt dat je gelijk bent waar je moet wezen* (B1)". In addition, despite the manual that already was provided, patients preferred more support in using the application. One patients mentioned that an online training regarding the use of the application should be incorporated: "*Maak het allemaal wat simpeler of geef daar iets van ondersteuning in, dat je er als het ware naast gaan zitten. Of nog beter, maak een online training voor je het kan gebruiken* (B3)".

Appearance

All patients were positive about the appearance of VitalinQ. Its appearance was graded with an 8 by each participant. Words that participants used to describe the appearance of the application were attractive, nice, clear, uncluttered, inviting, neat, fresh and gorgeous. Participants were in particular positive about the pictures of the meals in the application. However, one participant mentioned that on a small smartphone, these pictures could be too much: "*Op zich vind ik het ook wel leuk, die plaatjes. Maar ik denk dat je op een kleinere telefoon wel heel erg kriegel ervan wordt* (A4)".

Food diary

The majority of the participants was very positive towards the idea behind the self-monitoring food diary function. Most participant assumed that this function would help them with obtaining a healthier diet. Reasons that were given were increased awareness about the number of calories, sugars or fats in food

(e.g. "*Dat heb ik vroeger nooit gedaan, maar als ik dit bijhoud dan zie je pas van joh, als je een handje noten neemt, hoe veel calorieën het is. En daar schrik ik regelmatig van. Jeetje, zoveel calorieën, klopt dat wel? [..] Dus doordat ik dat bijhoudt en doordat ik dat dan zie word ik zelf veel bewuster van wat ik naar binnen werk* (B1)") and creating awareness about what healthy food is (e.g. "*Ja door dat bijhouden weet je gewoon wat je binnenkrijgt, en wat wel goed voor je is en wat niet, wat, ja* (B2)"). In addition, some participants mentioned that the confrontation of the nutritional feedback after entered meals and drinks was sufficient to motivate users to eat healthier through leaving high-fat and high-sugared foods out (e.g. "*nou je hebt een bepaalde vorm van confrontatie dan. En ook dat je dan denkt, ik kan nu wel chips nemen, maar wacht dat moet ik ook straks invoeren, nee ik neem toch maar een stuk komkommer. Dus omdat je weet, dat krijg je later weer te zien, doe je dat denk ik minder* (B5)").

Despite this positivity about the concept of this function, execution of the current food diary function was evaluated as not suitable for bariatric patients in specific. Participants and experts gave some suggestions for improvements and other needs that can be implemented in order to make the function more suitable for the current target group. The first suggestion that was given by most participants was targeted at the number of eating moments and eating times in which users can enter their food. To increase effectiveness and personalization, some participants suggested more flexibility in the current fixed six eating moments. Users should be allowed to enter the number and times of their own eating moments. In this manner, this function will become more structured and provides better insights in one's eating pattern (e.g. "*Maar wij hebben natuurlijk een heel ander eetpatroon dan dat het standaard daar opgeslagen is. Je hebt daar al de gezette vaste tijden erin staan wat je moet in staan. Dat moet je dan invullen, maar die tijden kloppen eigenlijk al niet met wat je eet en drinkt […] Ik zou dan zeggen van he, de tijden staan daar ingevuld, maar laat iemand zelf de tijden invullen, wat het voor ons overzichtelijker maken, waardoor je ook meer zelf kijk hebt op wat je eet en drinkt* (B4)").

In addition, patients found the standard portion sizes that could be entered in the current food diary function too large. For example, one participant mentioned that when she ate pizza, she can mostly only eat a maximum of two slices. However, the minimum pizza portion size that could be entered was one pizza, which was too much for her: *"Sowieso de standaard porties kleiner, want wij eten niet gauw 100 gram ergens van. Bijvoorbeeld ik eet max twee puntjes pizza. Maar dan kun je bij deze app kiezen uit één pizza, of per gram, en dan moet je invullen hoeveel gram je hebt gegeten. Ik ga dat niet wegen, dus dan moet ik een schatting maken. Eigenlijk zou je bijvoorbeeld één punt pizza moeten doen* (B4)".

Drinking diary

In the current application, drinks need to be entered in the same fixed 'eating moment' as their meals. However, since bariatric patients are not allowed to drink and eat simultaneously, some participants preferred to enter their drinks and meals separately: "*Maar ook dat het drinken erbij komt, dat je dat gescheiden van elkaar kunt invullen en niet alleen het eten van die tijdstippen en verder niet meer. Dat de tijdstippen ook los van elkaar zijn, dus dat je zelf de tijd kunt invullen van nou ik heb om 8 uur*

gegeten. Ik heb om 9 uur gedronken, en om 10 uur een appel gegeten. Dus vrijere eet- en drinkmomenten (B2)".

Nutritional feedback

Personalized nutritional feedback regarding deficits and excesses of daily entered meals was a highly appreciated function by all participants. However, some participants were not able to find this function. "*Nou ik hoopte dat er werd gesuggereerd van let op je eiwit is te weinig. Dat heb ik hier nog niet gevonden* (B1)". In order to simplify usability of this function, one patient suggested a button 'advice' on the homepage that comprised advices on the most important nutrient groups: "*Ik zou op de voorpagina een button met 'advies' zetten. Druk je daarop en dan zie je 7 of 8 belangrijke groepen en dan kan je daarop drukken. Eiwitten en dat soort dingen. En dan kun je precies zien wat je gebruikt hebt ja of nee. Dat zou ik heel handig vinden om erin te hebben* (B1)". Again, for this function, several other needs and suggestions were given to improve or adapt this feedback function.

Initially, the current application is focused on users with a 'normal' eating pattern. Therefore, nutrient feedback on for example calories that was given now was irrelevant and needs to be adapted to needs of bariatric patients "*Ja, maar het is wel zo dat deze informatie natuurlijk weer gericht zijn op een normaal voedingspatroon, dus eh. Ja dan is het net of je te weinig eet of eh he* (A4)". For example, the dietician explained that the number of proteins that a person needs after surgery is 0.8 per kilogram body weight, calculated back to a BMI of 27 (i.e. someone with a BMI of 30 does not needs proteins for the excess 3 kilograms body weight): "*Wij houden tot nu toe nog 0,8 gram per kilogram lichaamsgewicht aan. Kijk, iemand die 100 kilo weegt zou je dus normaal gesproken 80 gram eiwit adviseren. Maar heeft hij een BMI van 30, dan is een groter deel is vet. Dus zou je dat deel eigenlijk niet hoeven onderhouden met eiwit. Dus dan rekenen we hem terug naar BMI 27* (D)".

Some participants suggested variations in timing of nutrient feedback. In the current application it is only possible to view nutrient values and obtain nutrient feedback of the total number of meals that is entered in a day. Most participants found this sufficient, however, some suggested to also make it possible to request nutrient feedback of the different inserted meals over the day (e.g. the grams of proteins of breakfast): "*Dat er nog eens per maaltijd bij staat zoveel gram eiwit. En dat is dan echt gericht voor die bariatrie patiënten* (D)".

A more tailored, informative kind of feedback was preferred by some participants. Besides only getting information about nutrient deficits, they suggested that the application should also include tips on how to deal with this shortage. One example that was given was, when the application points out that one's proteins are too low, an option should be available that gives tips regarding what a user should eat in order to supplement this deficit: "*Dat je dan bijvoorbeeld, u heeft te weinig eiwitten, dat je dan onder eiwitten kan zoeken wat je dan nog het best kan eten om dit aan te vullen* (B5)". Another example that was given was that the application should give tailored feedback on meals that are entered. For example, the application suggesting "try to vary a bit more, by using this product" when users enter the same

breakfast every day: "*Dan zou eigenlijk het systeem moeten zeggen: "varieer eens". [...] als je elke keer hetzelfde eet, dat je in ieder geval de tip krijgt om te variëren. Probeer ook eens een ander ontbijt bijvoorbeeld* (A4)"

Lastly, some patients preferred to get more feedback, praise or reinforcing messages on 'how well they are doing that day', in order to increase motivation. "*En dan ook meteen een berichtje erbij hoe goed je bezig bent. Dat geeft toch wel wat extra motivatie natuurlijk* (B3)", "*Gewoon dat je, als je het een dag goed doet, ook een berichtje krijgt van ja goed gedaan ofzo* (B5)".

Recipes

The concept of providing varying recipes as a function in an eHealth application was rated positively by all participants. However, the current function was evaluated as not sufficient for bariatric patients, due to a variety of reasons. Initially, since bariatric patients can consume very little, the current recipes included too many ingredients, which will lead food wasting: e.g. "*De recepten die ze geven zijn voor ons niet relevant. Want het is voor ons, zeker als je alleen bent, niet te doen. Ben je met een gezin, dan kan je het klaarmaken. Maar voor een alleenstaande, doordeweeks, heeft dat geen zin om dat te gaan klaarmaken. Ik hou dan zo veel over wat ik weg kan gooien* (B4)". In addition, patients indicated that some ingredients were too expensive and that the current portion sizes were too large: e.g. *"En ik heb bijvoorbeeld in mijn weekbudget geen ruimte voor blauwe bessen met een gezin van vier. En er staan overal blauwe bessen* (B6)", "*Dus de porties zijn veel te groot. He, gezien de operatie dan he* (B6)".

Several suggestions for enhancement and other needs regarding this function were given by the patients and experts. Currently, it is possible for the application to take several allergies or lifestyle preferences into account. However, as previously stated, a problem after bariatric surgery is that patients have difficulties with the digestion of certain products, which can cause symptoms of dumping syndrome. Therefore, one participant and the nurse practitioner both suggested to implement a 'dumping products' option which allows users to exclude certain specific types of foods from the ingredient list. In this option, users must be able to check out products that needs to be (temporarily, until being unchecked) excluded from the recipes list. This will also support patients in making an overview of products that they are not able to eat yet. "D*at je kan bijhouden wat niet goed gaat. Want dan probeer je allemaal dingen weer te eten, en ik kwam er vrij snel achter dat ik geen kaas meer kon eten. Dan moet je een optie hebben dat je erin kan zetten geen kaas in de recepten. Dat hij dat er eerst uit haalt. En dan kan je het later eerst proberen, want soms kan je ineens iets wel weer eten. En dan kan je het vinkje weer weghalen* (B6)", "*een lijst van producten die ze niet kunnen eten. Als ze over gaan op vast voedsel kunnen ze ineens heel veel dingen niet meer eten. Doe er een optie in over dat ze dit bij kunnen houden. En als je het dan helemaal geschikt wil maken laat je die producten dan ook uit de recepten halen* (N)".

In addition, almost all participants suggested a shift in the current focus on fruit and vegetables towards a focus on proteins and fibers. As previously stated, bariatric patients need to focus their diet especially on these two nutrient groups. This could be implemented in the application by including

options for specific diets, such as high-protein, high-fiber or low-sugar diet recipes: *"Ik zou bijvoorbeeld een eiwitrijk dieet optie aan willen zetten […] En weet je niet alles hoeft eiwitrijk te zijn, maar het is wel fijn dat daar een extra stimulans in gegeven wordt, dus dat de keuzes daaruit bestaan* (D)". Furthermore, one patient suggested to extend the recipes searching option. In the current function, only certain types of foods (e.g. chicken) can be entered as searching words while looking for recipes. However, this patient preferred an option to search recipes with specific nutrient groups (e.g. proteins or fibers): "*En de zoekfunctie van recepten zou bijvoorbeeld kunnen worden uitgebreid met een stukje recepten zoeken met specifieke dingen. Ja dat is er wel met kip ofzo. Maar stel je komt in een week of een dag eiwitten of vezels ofzo te kort. Dat je kan zoeken van hee ik wil een recept met veel eiwitten erin* (B6)".

Lastly, several patients suggested an extension of the current recipes function by including a variety of tips, advices and recipes to support patients in the liquid period: "*Nou ja zeker in het begin de vloeibare periode tips en tricks* (A4)", "*en ook bijvoorbeeld in de vloeibare periode veel gerichtere adviezen wat je dan kan nemen* (B6)".

Challenges

Attitudes towards the use of challenges in order to achieve goals varied. Some patients had no interest in the use of challenges and indicated that use of challenges would even result in decreased motivation: e.g. *"Nee, ik ga fietsen als ik wil fietsen. Het moet geen moeten worden bij mij want dan ga ik het niet meer doen* (B6)". In addition, one patient mentioned that drinking or eating after bariatric surgery should not be something that is being enforced, as overconsumption could result in a dumping. For that reason, she was not interested in the use of eating and drinking-related challenges: "*Want bij ons is het ook gewoon zo, dat is met eten maar ook met drinken, doe je te veel, dan ben je gewoon misselijk en dan krijg je een dumping. Dus nee, ik zou dat niet gaan forceren* (B5)".

Other patients expressed more positive attitudes towards the use of a challenge to reach their goals. However, only one participant of sub group B had chosen one of the challenges in the testing period. This participant mentioned that she thought that this kind of a challenge might support users in reaching their goals, but that she often forgets that she was doing the challenge: "*Soms dacht ik 's avonds oh ja, dat had ik ook nog. Maar op zich het werkt wel. Als je echt zo'n doel aan wilt gaan dan kun je dat goed als ondersteuning gebruiken* (B6)". Some participants proposed the use of reminders in order to expand this function. This will be discussed further in the *Reminders* section.

Despite no more participants having tried the challenge function, most participants mentioned that they already often use other applications that are focused on challenges in order to achieve their goals. The majority of the participants already used smartphone applications that keep track of their amount of steps, in which they can enter and keep track of their own challenges and what gives a praising message when users reached it (e.g. "*Ja ik gebruik zo'n app waar ik mijn stappen op tel, die gebruik ik wel, alleen dan maar 6000 […] Ja, en dan aan het eind van de dag, ik haal hem wel altijd en dan krijg je zo'n poppetje erboven van u heeft het gehaald* (B2)". The current challenge function of VitalinQ does

not have an option for keeping track of steps without another device such as a smartwatch. In order to make an extensive broad eHealth application aimed at post-surgical support, some participants suggested to expand the current function so that it keeps track of steps without needing other devices: e.g. "*Dus als je nou zo'n programma maakt inclusief stappenteller, ben je klaar* (B1)*"*.

Regarding the content of challenges, all participants agreed to delete the fruit and vegetable challenge, as it is impossible to achieve the proposed daily amount. Other challenges that participants proposed during the interviews were 'stick to six eating moments and six drinking moments' and 'eat the recommended amount of proteins for a week': e.g. "*Nou ja voor de bariatrie zou het bijvoorbeeld kunnen zijn hou je aan je 6 eetmomenten. Eet ehm, een maand lang weet ik veel 100 gram eiwitten per dag ofzo* (A1)". Patients and professionals could not come up with more challenges.

Reminders

The current application does not have an option to provide reminders. However, the majority of the participants mentioned that they preferred some sort of reminders in a future application. Reminders for several functions were mentioned by both the patients and professionals. Participants suggested the use of reminders (e.g. alarms or pop-up messages) during eating and drinking moments, in order to not forget to eat or drink: "*Gaat er ook een wekker af tijdens eetmomenten? Dat zou wel handig zijn, een piepje of een belletje* (A5)", "*Gaat de app dan ook alarmeren? Vind het wel een goed idee dat je dat kan aanzetten wanneer je moet eten en drinken. Zeker met drinken* (A4)". In addition, reminders in order to not forget to take nutrient supplementation were mentioned: "*Misschien is het wel mooi, kijk als je hem echt multifunctioneel wilt maken, dat je er ook een reminder in zet. Van he, vergeet je pilletjes niet, zo iets. Ik hoor echt heel veel mensen, met pillen, maar ook bijvoorbeeld met het drinken, van ik vergeet het gewoon. Dus zoiets, dat je een soort alarm er in kan zetten* (B3)". Furthermore, reminder messages in order to increase adherence during the challenges was suggested: "*Ehm, ja een herinnering, van hee denk aan deze challenge […] van het is tijd om te drinken, anders haal je je challenge niet* (B6)". In specific, participants would like to receive reminders for step or movement challenges: "*En die suggestie moet hij eigenlijk doen halverwege de dag. Van let op, je hebt nog niet zo veel bewogen* (B1)".

Despite the expressed interest in the use of reminders by the majority of the participants, not all participants were positive towards this. One participant indicated that she was not in need of reminders, since she did not experience problems with eating, drinking, or nutrient supplementation. Others indicated that the use of reminders would possibly make them too nervous: *Ik heb wel een poosje een wekker geprobeerd te zetten van dan moet ik eten en dan moet ik drinken, maar dat werkt voor mij gewoon niet. Ik moet niet op die tijden staan want daar word ik helemaal zenuwachtig van* (B5)".

In order to not become overloaded with the number of reminders, patients preferred a way to turn these reminders on and off easily. In addition, flexibility for the type of reminders that users would like to receive was suggested: "*Ja, en dat je dan zelf kan bepalen waar je hem voor wilt gebruiken: voor medicatie, voor eten of drinken. Maar dat zou misschien wel mooi zijn, ja* (B3)".

Peer support

The opinion towards incorporating features regarding peer support conflicted. A part of the participant stated very confidently that they would never use social functions aimed peer support, because they were not in need to chat with other bariatric patients or they did not like online group forums: "*Nou ik zag net dat chatten, maar daar heb ik helemaal geen behoefte aan. Ik hoef niet zo nodig te praten met andere mensen* (A4)", "*nou ik ben zelf helemaal geen groepsapp of forum mens, dus ik mis dat niet* (B6)".

Other participants were more positive towards functions of peer support. Several suggestions and needs for options that they preferred in a future eHealth support intervention were given. Some participants preferred an online forum with options for questions and answers. In addition, a number of participants suggested an option to share (high-protein) recipes. One participant also suggested an option to rate or grade these online recipes, so that it becomes easier to view directly what was highly reviewed by peers: "*ook dat je zelf tips kunt inbrengen, of vragen, dat mensen kunnen antwoorden* (B4)", "*ja, en misschien is het ook wel een leuke als er dan een functie in kan zetten dat je iets van communicatie met medegebruikers kan hebben. Dat je er recepten op kunt zetten, maar dat je daar dan ook beoordeling over kan geven […] Want dan weet je ook van dat is al geprobeerd en anderen vonden dat goed* (B5)*"*

The nurse practitioner indicated that some kind of privacy in a future application should be requisite, especially regarding weight loss numbers. Patients tend to compare themselves with others, however, they could become very demotivated when noticing other patients who are losing more weight. Therefore, she suggested that the profiles of bariatric patients need to stay private. "*Je moet iets vinden waardoor ze het niet met elkaar gaan vergelijken. Patiënten willen zichzelf altijd vergelijken met elkaar terwijl de een 160 kilo is en de ander 197. Die gaan nooit hetzelfde resultaat hebben* (N)".

Monitoring of weight

Another need that emerged from the interviews was the implementation of a function to keep track of weight loss. By means of a weight curve function, based on preoperative weight, users want to keep an overview of their weight and see how far they already have become or how much more weight they still need to lose in order to reach their personal target. In addition, a reward system that provides praises or rewards when BMI has decreased another point, was mentioned by the nurse: "*ja wat ik wel zou willen, zo'n curve, waar je dan bijvoorbeeld elke week je gewicht invoert. Zodat je ook een beetje ziet hoe ver je al bent, of juist niet he, hoe veel je nog moet* (A5)". "*Ja of je moet een ander beloningssysteem erin maken dat je zegt gefeliciteerd uw BMI is weer een punt gedaald ofzo* (N)".

User-requirements of a future eHealth support system

Based on outcomes of the interviews about evaluation of VitalinQ and about other values that they deem important, user-requirements are drafted. An example of the process of generating a user-requirements was given in the method section. Several user-requirements regarding the categories usability, appearance, food diary, feedback, recipes, challenges, reminders, peer support, privacy and weight monitoring are generated and listed in Table 12.

Table 12

User-requirements for a future eHealth intervention

Category	User-requirement
Usability	1. The app contains a clear, simple home page menu, with recognizable buttons directed to main functions.
	2. The app contains an online training session with explanation of the application.
Appearance	3. The app has an outlook that is visually attractive and include pictures.
Food diary	4. Users can fill in flexible numbers and times of eating moments.
	5. The app contains separate drinking and eating moments.
	6. The app contains small standard portion sizes what facilitate adding meals.
Feedback	7. The app provides nutritional feedback of each meal.
	8. The app provides nutritional feedback that include tips regarding dealing with nutrient deficits.
	9. The app provides positive reinforcement messages when users lose a BMI point or when users took in sufficient nutrients.
Recipes	10. The app contains recipes with a small number of ingredients.
	11. The app provides nutrient values of each recipe.
	12. The app include recipe options for various diets: - high-protein - high-fiber - low-fat - low-sugar/ sugar-free - low-carbs
	13. The app contains a search function in which users can search for recipes with certain nutrients.
	14. The app contains an option to opt out (expensive) products.
	15. The app contains a 'dumping products' list, in which users can keep track of products they are (temporarily) not able to eat. The app exclude these products from the ingredient list.
Challenges	16. The app contains an option for users to enter their own preferred challenges.
	17. The app contains a pedometer function that keeps track of steps.
	18. The app contains suggestions for a protein and eating-moments challenges.
Reminders	19. The app contains an option to switch the different reminders on and off.
	20. The app contains an option for different reminders: - reminders for eating moments - reminders for drinking moments - reminders for multivitamins / nutrient supplementation - reminders for challenges – in specific: reminder for daily steps
Peer support	21. The app contains an option to upload recipes to a bariatric forum and an option for users to react on and rate these recipes.
	22. The app contains an online bariatric Question & Answer forum, in which users can upload questions, experiences and comments.
Privacy	23. The profile of users is private.
Monitoring weight	24. Users can keep track of their weight loss process by means of a weight curve.
	25. The app provides tailored feedback on weight loss, including praising messages during the loss of one BMI point and compassionate messages on times of stagnations.

Discussion study B

To eventually develop an eHealth technology that matches needs of the target group, this study aimed to obtain insights into problems after bariatric surgery, attitudes towards eHealth and needs and preferences for a future support application. Interviews with bariatric patients revealed some frequent occurring postoperative problems, of which the vast majority was eating or drinking related. Further questions revealed a positive attitude towards eHealth in general. An existing application however, was evaluated as not yet sufficient as it lacked usability and bariatric-related possibilities. To make it efficient for the target group, several suggestions for improvement, needs and preferences emerged. These values were related to usability, food diary, feedback, recipes, reminders, peer support and keeping track of weight. The main findings will be discussed in further detail in this discussion, and will be further analyzed using a persuasive technology model. Results and user-requirements of this study can be used both during the development of a new eHealth application as during possible further extension of the existing application VitalinQ.

Main findings

Postoperative problems and barriers

The first aim of this study was to determine problems and barriers that bariatric patients experience after surgery. In general, the period that follows a bariatric surgery is perceived as quite difficult by a considerable part of the patients. The vast majority of the sample, including the professionals, mentioned dietary non-adherence in the form of overeating or eating too little. Both can result in suboptimal bariatric outcomes. Patients mentioned that they often forget to eat due to the lack of appetite. Moreover, food intolerance leading to dumping symptoms was mentioned often. The following anxiety to eat certain foods appeared to be another cause of eating too little. Patients who fail to eat the recommended vitamin and mineral intake could get nutrient deficits and malnutrition problems (Sarwer et al., 2011). Overeating is a problem that occurred more often later in the bariatric trajectory. Although surgery initially reduces the amount of food that can be consumed, patients experience a decrease in food intolerance and dumping symptoms later in their trajectory (Sjöström et al., 2004). As a result, patients are again able to eat more, which leads to weight regain. Other eating-related problems that emerged, such as difficulties with sufficient protein intake and not knowing what to eat, all highlight the importance of sufficient and regular postsurgical dietary support. This was earlier mentioned in several reviews (McGrice & Don Paul, 2015; Conceição, Utzinger, & Pisetsky, 2015).

As mentioned in the results, mental or psychosocial problems hardly emerged during this study. This is in line with previous findings in study A. The psychosocial problems that did emerge during the current study were related to findings of another qualitative study towards postsurgical problems (Coulman, MacKichan, Blazeby, & Owen-Smith, 2017). Both comprised fear of weight regain and more confidence in social activities, leading to negative comments of surroundings. From literature, it appeared that mental problems such as depression, especially in the first year, might be overwhelmed

and reduced by the positive feelings related with losing such a great amount of weight (Booth et al., 2015). Mental problems are starting to (re-)occur more frequently in a later stage of the bariatric follow-up. Future eHealth developers should therefore consider including options for psychosocial support, especially when the aim of the intervention is to support users over a longer period. Also, it would be beneficial to implement features that early detect the arising of psychosocial issues among users, in order to provide patients with sufficient (online) mental support options.

Attitudes towards eHealth and VitalinQ

In the current study, an existing healthy lifestyle support application, VitalinQ, was used and provided to the participants in order to operationalize the process of obtaining needs. In addition, by providing such an application, participants could obtain an impression of eHealth. In general, patients and professional expressed positive attitudes towards the use of an eHealth application during the post-bariatric trajectory. Moreover, this study demonstrated their need for online interventions that are specifically bariatric-focused. Regular online dietary or lifestyle applications are not sufficient to implement among bariatric patients, as they require different dietary recommendations than the non-bariatric population. The attitudes towards VitalinQ varied. What appeared was that the bariatric patients were positive about its concept and focus on self-monitoring, dietary feedback and recipes. However, after participants tested the application, they reported low usability and lack of bariatric-focused possibilities. This lead to a significant decrease in this positivity. Since the application was originally not focused on bariatric patients, this low rating was considered as logical. Nevertheless, the interviews with the patients and experts has led to valuable insights that could be used to develop a new eHealth system or to improve and implement in the current VitalinQ application. Values that emerge in this study are both bariatric and general requirements. Therefore, they can also be used to further improve VitalinQ for the general population.

Findings of this study highlight the importance of participatory and user-centered design approaches, such as the CeHRes roadmap (van Gemert-Pijnen et al., 2011), over a technology-driven approach without taking the users perspective into account (Van Velsen, Wentzel, & Van Gemert-Pijnen, 2013). According to user-centered approaches, users and relevant stakeholders need to be included throughout the development process of eHealth technologies. Involving them in processes such as the generation of user-requirements, usability testing and interim evaluations, will increase uptake, impact, user-satisfaction and adherence of the interventions (van Gemert-Pijnen, Peters, & Ossebaard, 2013). Interviewing the target group has to valuable needs regarding functions and usability. The needs that arose will be further analyzed in the *persuasive technology* section below.

Persuasive technology

In order to attain positive bariatric surgery outcomes such as weight loss and mental health, postsurgical behavior change is required. A persuasive technology is defined by Fogg (1998) as an interactive technology that changes a persons' attitudes or behaviors. Therefore, the future eHealth support

intervention could be seen as a persuasive technology. To eventually develop an application that is effective in supporting users with postsurgical behavior change, the current findings, needs and preferences that arose in this study will be further analyzed by using the Persuasive System Design (PSD) model of Oinas-Kukkonen and Harjumaa (2009). This PSD model can be used as an approach during the design of a persuasive technology. It defines four categories that comprise several design principles that can be incorporated in a persuasive technology, in order to achieve behavior change. The *primary task support* category contains features that focus on supporting users in carrying out primary tasks, in order to reach the goal of the intervention (in this case to improve bariatric surgery outcomes). Design principles from the *dialogue support* category are focused on providing the user some degree of feedback. Principles in the *credibility support* category are targeted at increasing the credibility and therefore the persuasiveness of a system. Lastly, the *social support* category contains design principles that motivate the users by leveraging social influence. Figure 3 provides an overview of the PSD model and its comprising categories and features.

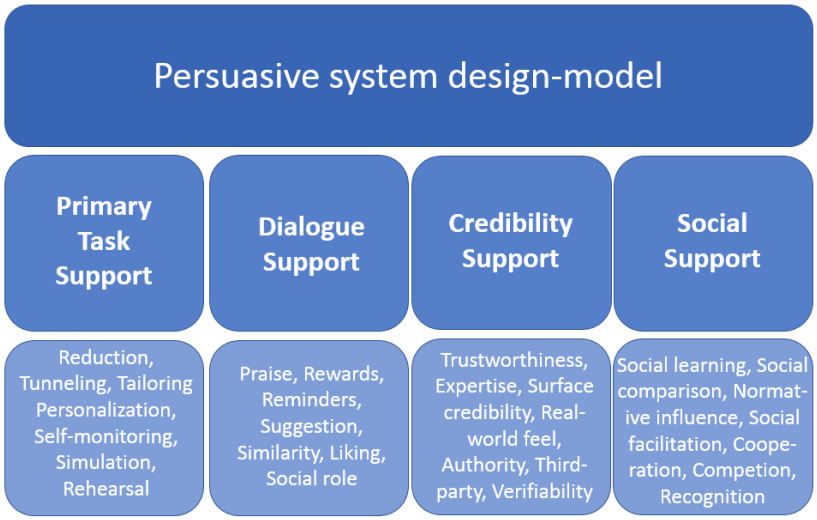

Figure 3. The Persuasive System Design-model (Oinas-Kukkonen and Harjumaa, 2009).

Primary task support

Several eHealth needs that emerged during the interviews are relatable to features of the primary task support category. The first refers to *self-monitoring*, defined as letting a user keeping track of own functioning or behaviors. Participants were positive or expressed interest towards self-monitoring on different levels; self-monitoring of food intake, self-monitoring of fluid intake, self-monitoring of physical activity (i.e. steps) and self-monitoring of weight (change). Several patients proposed that this self-monitoring would help them with the intake of healthier food, by creating awareness about healthy food. These findings are in concordance with previous positive findings of self-monitoring. It was described as the most effective technique of behavioral treatments of obesity (Burke et al., 2011) and is showed to increase self-awareness and knowledge, and therefore positively influence eating and exercise behaviors (Heesch Mâsse, Dunn, Frankowski, & Mullen, 2003). The recommended frequency of self-

monitoring of weight change after bariatric surgery differs. Some experts recommend daily weighing, whilst others found increased effectiveness of weekly weighing (Sarwer et al., 2011)

The current application contains several functions that could be related to *tailoring*, which is based on the principle that a system will be more persuasive when it is tailored to the needs, interests and personal data of users. The application does so by letting users enter personal data such as weight, allergies and lifestyle preferences, on which recipes and online feedback were adjusted. However, participants favored the system to be more tailored to their personal diet needs. For example, they preferred more high-protein, high-fiber and low-(fruit)sugar diet recipes, with a low number of ingredients. In addition, they desired smaller standard portion sizes to enter meals in the food diary function. Also, tailored nutritional feedback was mentioned and appreciated. By implementing tailoring of content, relevance of information that is presented will be enhanced, what leads in general to greater desired behavioral changes (Kreuter & Wray, 2003). In addition, several suggestions for *personalization* arose. Personalization is based on the principle that a system is more persuasive, thus leading to more behavioral change, when it offers personalized content. For example, participants desired to opt out products that previously lead to dumping syndrome symptoms, making content regarding recipes more personalized. In addition, they wanted to enter personal challenges, instead of the fixed challenges that the application currently contains. These findings regarding need of personalized content are relatable with a similar study that targeted physical and dietary behavior change interventions (Rabbi, Pfammater, Zhang, Spring, & Choudury, 2015).

Dialogue support

Several needs for dialogue support features arose from this study. Initially, some patients and experts suggested incorporating positive reinforcement messages to increase motivation, which can be related to *praise*. Second, a frequent mentioned feature that participants wanted in an eHealth system was the use of *reminders*. Both reminders for eating, drinking or taking nutrient supplementation, as reminders for challenges were suggested. It would be beneficial to implement reminders into an application, because they previously appeared to enhance physical activity (Fanning et al., 2012), weight loss (Fry & Neff, 2009), and more adherence to interventions (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012). In addition, several patients would like to receive informative feedback including tips and recipes regarding dealing with nutrient deficits. This requirement could be related to *suggestion*. By implementing diet suggestions into nutritional feedback, the system guides users towards a healthier diet, which facilitates behavior change and thus makes it more persuasive. The last feature that arose from the interviews was *liking*, based on the principle that a system is more persuasive when it is visually attractive. Patients indicated the application as attractive, which motivated them to start using it.

Credibility support

Both patients and professionals expressed positive feelings against the *expertise* of the system. Through stating that the application is based on scientific research and collaboration with dieticians and

physiotherapists, the system was viewed more positively. No additional credibility support needs arose from the interviews. However, since credibility increase persuasiveness of technologies, it could be interesting to incorporate credibility support features. One way to do this is by increasing *third-party endorsement* from well-known and respected sources. Through implementing logos or recommendations of the medical institutes where bariatric patients underwent surgery, users will be ensured that the application is reliable and therefore presumably will expose more positive feelings towards it. In addition, this makes the system more reliable, making it also coherent with the design principle *trustworthiness*.

Social support

In this study, several online support needs emerged. These findings corresponded with a previous study that also established a need for online social support, especially regarding peer support to share experiences and information (Sharman et al., 2015). The participants of the current study suggested an option to share (high-protein) recipes with fellow bariatric users, which can be related to the persuasive system design principle *cooperation*. Moreover, this principle can also be related to the patients' need for an online forum where they could share experiences and questions. Results towards efficacy of online support on bariatric outcomes is scarce, however, a study of Das and Faxvaag (2014) pointed out that participating an online discussion forum benefits bariatric patients. Patients in that study mentioned to use the forum for informational and emotional support and acknowledgement of fellow patients.

Despite the positive effects on behavior change that are generally related with social support (Oinas-Kukkonen and Harjumaa, 2008), some patients expressed no interest in online contact with other bariatric patients. Moreover, functions related to *social comparison*, based on the principle that comparison of performances lead to greater motivation, was mentioned by the professionals as something that needs to be avoided. In specific, making patients able to compare weight loss outcomes with others might lead to demotivation and decreased self-esteem. A future eHealth intervention should implement options for social support by including options to share information, experiences and questions. However, privacy was perceived as important and users should be able to determine themselves whether they would make use of online support functions.

Limitations, strengths and future recommendations

The current study have led to important values and findings on which future studies and eHealth developers could continue. Future studies need to take the limitations of this study into account. The first limitation is the relatively small number of participants that tested the application, which possibly led to an inability to achieve saturation for requirements. However, according to Virzi (1992), the sample size of six patients that tested the application for a period of two weeks met the recommendation for usability testing. In his study, it was found that 80% of the usability problems could be detected with four or five participants. The second limitation in the present study was the lack of variance in demographic characteristics, because we were not able to recruit participants based on specific

prerequisites. As an example, this sample comprised only two male participants. In addition, only one participant completed high-level education. To increase generalizability of results and to develop an intervention that is suitable for a broad range of participants, future studies should increase sample size and sample variety. Moreover, when the aim is to design an application that also suits interests of bariatric patients in a later stage after surgery, these should also be include in future studies. The third limitation was the technical issues of the VitalinQ application, which impede participants to test the application properly. However, due to the general interview questions, even participants that were not able to use the application frequently gave valuable insights into requirements they would prefer in a future technology. The last limitation was the data analyzing process that was executed by only one researcher. To increase trustworthiness, coding of interviews should be done by at least two researchers.

One noteworthy strength of the current study is the use of a user-centered and participatory design approach. Including bariatric patients and other stakeholders have led to the formulation of valuable bariatric-focused user-requirements, which will most likely lead to improved adherence and uptake of the future intervention. The other strength of this study is focused on the use of a qualitative approach. Qualitative studies about technology evaluation help technology developers to match the design with needs of target users and therefore enhance adherence (Kulyk et al., 2014). The use of semi-structured interviews in specific allows researchers to direct the interviews, yet allowing participants to mention other kind of information as they prefer.

This study lays an important foundation for future studies and eHealth developers. A strong need for a bariatric-focused eHealth support system emerged. The findings and requirements that were drafted during this study should be used during the design of a new eHealth behavior change support system, or during the further development of VitalinQ. In addition, researchers and developers should continue to follow design models such as the PSD model (Oinas-Kukkonen & Harjumaa, 2009) and user-centered approaches such as the CeHRes roadmap (van Gemert-Pijnen et al., 2011). This recommendation will be further elaborated in the *General discussion* section.

Another interesting thing to build further on is the high interest and positive attitudes towards the use of self-monitoring, expressed by the participants. This approach is following the current trend towards interest in self-management of own (mental) health. It is interesting to investigate sufficient ways to provide online coaching or tailored feedback based on self-monitored data, in order to enhance behavior change. Moreover, the earlier mentioned finding of the initial decrease, but possible longer-term reoccurrence of depressive symptoms, lays another recommendation. Self-monitoring of mental status could be beneficial to implement in an eHealth technology to provide patients with online mental support.

General discussion

An extensive reflection on both sub studies has already been provided in the discussions. This general discussion will focus on combining the results of the studies, stating the relevance of the results and the mixed methodology that was used during this study, and providing recommendations to continue on the findings. Both sub studies have provided significant relevance for the field of eHealth and bariatric surgery. In study A, several psychological characteristics were found to predict or be related with weight loss. However, since the bariatric procedure itself is most likely the biggest predictor of weight loss within the first six months, this study needs to be continued to detect the importance and prediction of psychological variables on weight loss over a longer period of time after surgery. The study provided many insights into the psychological profile of patients before, and the extent that they changed to six months after surgery. Insights into this profile and short-term changes that arose in this study are very useful to determine the typical psychosocial problems and barriers of bariatric patients. Therefore, it can be used to determine how we should provide (eHealth) support to bariatric patients after surgery.

During study A, mental problems were not found to be a major issue within the current patient group, yet some patients scored above the clinical threshold. Although higher depression was found to predict more weight loss, literature showed the importance of treating depression after surgery. A future eHealth system should therefore include options for mental support provision. Moreover, it should contain options to early detect the arising of a broader range of psychosocial issues, as another finding was the high decrease in social support that occurred already at six months after surgery. Furthermore, because it was found that a higher increase in exercise was associated with more weight loss, technologies should focus on motivating the user to increase their exercise. Implementing a pedometer function in combination with a step challenge was indeed appointed by the participants of study B. Food craving was another predictor of weight loss. It was found as very high before surgery, but reduced tremendously after six months. Reduces in especially emotional craving were associated with more weight loss. Also, this study showed a trend towards lower self-compassion and an association between an increase in self-compassion and more weight loss. In order for a technology to assimilate these results, it is interesting to incorporate features aimed at reducing food craving or improving self-compassion.

The investigation into the psychological characteristics of study A was extended with a more eHealth-related needs assessment in study B. Bariatric participants showed great agreement and enthusiasm with the concept, goals and philosophy behind VitalinQ. However, this current application was found as not sufficient to implement within bariatric aftercare, as it lacked usability and bariatric-focused options and coaching. The main conclusion that this study showed is that there is much more to be gained in the current (eHealth) support for patients in the aftercare of bariatric procedures. Only in the Netherlands, around 10.000 people with severe obesity annually undergo some type of bariatric procedures. eHealth has the potential to foster or support behavior change in order to promote and maintain health (Oinas-Kukkonen & Harjumaa, 2009). It could therefore have added value in supporting

bariatric patients and preventing weight regain on the longer term. The present study indeed highlighted the major desire for bariatric-focused eHealth interventions. However, no specific bariatric-focused eHealth interventions are currently available in the Netherlands. Interviews with bariatric patients and professionals provided various values, recommendations and user-requirements, which can be used to develop a new bariatric eHealth intervention, but will also be useful to implement in the current VitalinQ application. It will have major clinical relevance to continue the developing of a bariatric eHealth intervention, to increase the chance of obtaining and maintaining positive health outcomes after surgery.

Future eHealth developers should continue to use and incorporate design principles of the PSD model, in order to make any future behavior change support technology persuasive (Oinas-Kukkonen & Harjumaa, 2009). Moreover, to increase uptake and relevance of the technology for bariatric patients, future eHealth developers should continue to follow user-centered and participatory design models, such as the CeHRes roadmap (Van Gemert-Pijnen et al., 2011). One way to do this is by continuing the mixed-methods approach that has been applied in the current study. We have combined qualitative approaches in which needs and values of stakeholders were determined, with qualitative survey approaches in which psychosocial characteristics were determined. These needs and characteristics are important for an eHealth technology to be accepted, adopted and adhered to by the target group (Van Gemert-Pijnen et al., 2018). Our results combined has already led to important values and requirements that should be targeted by eHealth technologies, which can be used as a reference and guidelines for future developers. Future researchers should extend these mixed methods to ultimately obtain a broad picture of the psychosocial characteristics, problems, and eHealth support needs in bariatric aftercare.

It can be stated that with the mixed methods executed in the current study, the first two phases of the participatory CeHRes roadmap have been executed; the *contextual inquiry* and *value specification* phases (Van Gemert-Pijnen et al., 2011). It is recommended that future eHealth developers continue to apply the next phases of this roadmap during further developing of a technology. In the *design* phase, user-requirements should be translated into technical requirements and prototypes. This phase ensures co-creation of the technology with end-users and stakeholders, to develop a user friendly, meaningful and adequate eHealth technology. In the *operationalization* phase, implementation issues should be concerned. Operationalization plans and business models should be made to guide and steer the adoption process, and to define resources and cost-benefits of the technology (van Gemert-Pijnen et al., 2013). In the final *summative evaluation* phase, the eHealth technology should be evaluated. In this phase, uptake and clinical, organizational and behavioral outcomes (i.e. impact) of the technology should be assessed. The CeHRes roadmap is an iterative process, so outcomes of summative evaluations could result in improving or redesigning the eHealth technology to ensure the design of a sustainable and cost-effective technology. Lastly, *formative evaluations* during the entire development process should be performed to evaluate the products of each phase and to provide information on how to improve or modify them. This latter is also important to early detect usability problems, which appeared to be a major issue in the current application that has been used for the purposes of this study.

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Appendix A

Dutch manual of VitalinQ

umcg

Handleiding en opdrachten voor het uittesten van VitalinQ

De testperiode

Nogmaals hartelijk dank voor uw deelname aan dit onderzoek. Voor het onderzoek vragen wij alle deelnemers om gedurende 14 dagen de VitalinQ applicatie (app) uit te proberen.

Na afloop vindt een telefonisch interview plaats over ervaringen met de app en eventuele verbeterpunten.

Om u een beter inzicht te geven in de app hebben we een aantal kleine opdrachten bedacht die te maken hebben met het gebruik van de app. Deze opdrachten met uitleg staan verderop in deze handleiding omschreven.

We zouden u willen vragen om in het begin van de testperiode al naar deze opdrachten te kijken. Ook willen we u vragen om gebruik te maken van de schrijfruimte. Hier kunt u opmerkingen of problemen kwijt die u heeft tijdens het uitvoeren van de opdrachten.

Over 14 dagen zal ik u bellen voor een telefonisch interview, zou u dit boekje inclusief opmerkingen bij dit interview willen houden?

Handleiding VitalinQ

In de bijgevoegde handleiding staat een uitgebreidere uitleg over de app. In deze handleiding zal een kortere uitleg worden gegeven over de belangrijkste onderdelen van de app:

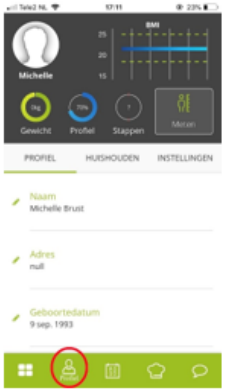
1

Aanmelden

VitalinQ kan gedownload worden via de App Store (iPhone) of Google Play Store (Android).

Uw inlog e-mailadres is:

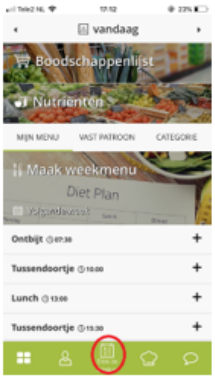
Uw wachtwoord is:



Op het tabblad '*Profiel*' kunnen persoonlijke gegevens worden ingevuld. Zoals u ziet op dit plaatje bestaan de gegevens uit naam, adres en geboortedatum. Als u verder naar beneden scrolt kunt u ook allergieën, leefstijlvoorkeuren en medische aandoeningen (zoals diabetes) toevoegen.

Daarnaast kunt u onder 'Meten' uw persoonlijke meetwaarden, zoals gewicht en lengte, invullen en aanpassen.

Er wordt aangeraden om zo veel persoonlijke gegevens en meetwaarden als u weet in te vullen, omdat de recepten hier op worden aangepast.



Als u op '*Eten en drinken*' klikt, ziet u de volgende pagina →

Mijn menu:
Onder mijn menu kunnen eetmomenten inclusief tijdstip worden ingesteld. Per eetmoment kunt u recepten of producten toevoegen door op + te klikken.

U kunt ook klikken op 'Maak weekmenu', waarna de app zelf een weekmenu voor u maakt. Door op een eetmoment te klikken ziet u de bereidingswijze en ingrediënten.
Eenmaal een dagmenu gemaakt te hebben, kunnen eetmomenten worden verwijderd door een recept naar **rechts** te swipen. U kunt dan bijvoorbeeld een eigen recept toevoegen. Als u een recept naar **links** swipet, verschijnt er een ander recept.

Vast patroon:
Als u een bepaald vast patroon hebt (u eet bijvoorbeeld elke ochtend kwark), dan kunt u dit onder dit tabblad instellen. U hoeft dit dan niet meer elk eetmoment apart in voeren.
Nutriënten:
Onder nutriënten kunt u zien wat u die dag aan voedingsstoffen (zoals eiwitten) hebt binnengekregen. Hier is te zien welke u te weinig, genoeg, of zelfs te veel heeft binnengekregen.

Het onderdeel '*Recepten*' bestaat uit twee tabbladen: Recepten en Mijn recepten.

Recepten:
Via de zoekbalk bovenin kunt u zoeken naar recepten en gerechten. Typ bijvoorbeeld 'kip' in, en er verschijnen recepten met kip.

Door op een recept te klikken, kunt u de bereidingswijze en ingrediënten zien. Ook kunt u een instellen wanneer u het wilt gaan eten, door op 'dit ga ik eten' te klikken.

Via het sterretje rechts bovenin kunt u recepten toevoegen aan uw favorieten. Ze komen dan te staan onder het tabblad Mijn recepten.

Onder 'Mijn recepten' staan uw opgeslagen favoriete recepten.

Ook kunt u zelf een eigen recept toevoegen, door op + te klikken. Dit kan inclusief eigen gemaakte bereidingswijze, ingrediëntenlijst en foto.

Op de '*Homepagina*' krijgt u direct suggesties wat u vandaag en morgen kunt eten.

Daarnaast kunt u in het tabblad 'Challenges' (uitdagingen) kiezen uit een aantal uitdagingen die u aan wilt gaan.

U kunt bijvoorbeeld als challenge kiezen om een week lang een aantal stappen per dag te zetten.

Apparaten zoals een Fitbit kunnen worden gekoppeld aan de app (onder *Profiel* – Instellingen). Op deze manier kunnen challenges goed worden bijgehouden.

1. Eén of meerdere recepten van de app uitproberen.
Zie deze handleiding pagina 3 en 4.

2. Eén of meerdere dagen zelf bijhouden en invoeren wat u die dag eet en daarvan de voedingswaarden bekijken.
Zie deze handleiding pagina 3.

3. Eén van de challenges kiezen.
Belangrijk: omdat de huidige app nog niet is aangepast is het aantal gram groente en fruit waarschijnlijk te hoog voor na een bariatrische operatie. Het is aan te raden om één van de andere twee challenges te kiezen.

Ruimte voor opmerkingen:

4. Nadenken en noteren wat u mist in de huidige app of wat u wilt zien in een toekomstige app.

5. Enkele positieve en negatieve aspecten van de app noteren.

Ruimte voor opmerkingen:

Appendix B

Interview guide A-participants

Doel van het onderzoek:
Het uiteindelijke doel van dit onderzoek is het ontwikkelen van een smartphone voedings- en bewegingsapplicatie dat gericht is op het ondersteunen van mensen die korte tijd geleden een bariatrische operatie hebben ondergaan. Voor het ontwikkelen van deze applicatie wordt een bestaande smartphone applicatie gebruikt als basis. Om de applicatie geschikt te maken en goed te laten aansluiten bij de wensen en behoeften van de doelgroep worden interviews gehouden. Uitkomsten uit deze interviews zullen gebruikt worden om de applicatie aan te passen, zodat deze geschikt wordt voor mensen die een bariatrische operatie hebben ondergaan. Uw inbreng wordt dus erg gewaardeerd en is erg van belang voor dit onderzoek. Vragen tijdens dit interview zullen gericht zijn op het verkrijgen van inzicht in hoe u de periode na de operatie heeft gevonden, het informeren naar de behoefte aan ondersteuning en het verkrijgen van wensen, behoeften en vereisten met betrekking tot de applicatie. Dit interview zal ongeveer 20 minuten duren.

- **Toestemming audio-opname:** Vind u het goed dat ik dit interview opneem? Ik zal geen persoonlijke gegevens vragen tijdens de opname. Opnames zullen met een wachtwoord beveiligd worden opgeslagen en zullen alleen gebruikt worden voor dit onderzoek.
- **Informed consent**
- **Vragen:** Heeft u nog vragen voor we beginnen?

Demografische gegevens:

- Leeftijd
- Datum operatie
- Relatiestatus
- Opleiding
- Werk

Problemen met voeding:
Wat is uw huidige voedingspatroon? (Hoe vaak per dag, hoe veel?)

Hoe gaat het met eten? Wat is lastig? Heeft u problemen ervaren met uw voeding sinds de operatie?

Andere problemen:
Heeft u problemen ervaren na uw operatie? Wat vond u lastig/moeilijk?

Behoefte aan ondersteuning:
Had u behoefte aan ondersteuning op het gebied van voeding of beweging na uw operatie?

Had u behoefte aan ondersteuning op andere gebieden na uw operatie?

Wat voor ondersteuning heeft u gehad na uw operatie?

Wat voor ondersteuning heeft u gemist na uw operatie?

Behoefte aan app ondersteuning:
Heeft u een smartphone met internetverbinding?

Heeft u gebruik gemaakt van apps of websites die gericht waren op voeding en sport na uw operatie?

Zo ja, welke apps of websites heeft u gebruikt?

Zo ja, heeft u het gevoel dat de apps of websites u geholpen hebben met uw voeding of beweging?

Zo ja, wat waren nuttige en minder nuttige aspecten aan de app of website?

Zou u gebruik maken van een voeding of beweging app of website die speciaal gericht zou zijn op de periode na een bariatrische operatie?

Wat zou deze app of website volgens u moeten kunnen of bieden?

Wat / welke functies zouden voor u redenen zijn op de app niet te gebruiken?

Tijdens het laten zien van VitalinQ:
Wat is uw eerste indruk van de app?

Vind u het er overzichtelijk en aantrekkelijk uit zien?

Wat is uw eerste indruk van de:

- Receptenmogelijkheid
- Voedingsdagboek / eetmomenten
- Challenges: wat voor challenges zou u toevoegen?
- Eetmomenten

Zou u naar aanleiding van wat u hebt gezien de app gaan gebruiken?

Zijn er onderdelen die u mist in de app?

Zijn er overbodige onderdelen in de app?

Kan u naar aanleiding van dit voorbeeld verder nog dingen bedenken dat u in een toekomstige app willen zien?

Appendix C

Interview guide professionals

Doel van het onderzoek:
Het uiteindelijke doel van dit onderzoek is het ontwikkelen van een smartphone voedings- en bewegingsapplicatie dat gericht is op het ondersteunen van mensen die korte tijd geleden een bariatrische operatie hebben ondergaan. Voor het ontwikkelen van deze applicatie wordt een bestaande smartphone applicatie gebruikt als basis. Om de applicatie geschikt te maken en goed te laten aansluiten bij de wensen en behoeften van de doelgroep worden interviews gehouden met patiënten en professionals. Uitkomsten uit deze interviews zullen gebruikt worden om de applicatie aan te passen, zodat deze geschikt wordt voor mensen die een bariatrische operatie hebben ondergaan. Vragen tijdens interviews met patiënten zullen gericht zijn op het verkrijgen van inzicht in hoe u de periode na de operatie heeft gevonden, het informeren naar de behoefte aan ondersteuning en het verkrijgen van wensen, behoeften en vereisten met betrekking tot de applicatie. Omdat u betrokken bent bij de nazorg van de doelgroep en daarnaast hier veel kennis over heeft, is uw inbreng als een professional ook erg van belang. Dit interview zal ongeveer 20 minuten duren.

- **Toestemming audio-opname:** Vind u het goed dat ik dit interview opneem? Ik zal geen persoonlijke gegevens vragen tijdens de opname. Opnames zullen met een wachtwoord beveiligd worden opgeslagen en zullen alleen gebruikt worden voor dit onderzoek.
- **Vragen:** Heeft u nog vragen voor we beginnen?

Het interview:
In hoeverre bent u betrokken bij de nazorg van de bariatrische patiënten?

Denkt u dat bariatrische patiënten na hun operatie moeilijkheden hebben op het gebied van voeding en beweging? Wat voor moeilijkheden?

Denkt u dat bariatrische patiënten na hun operatie moeilijkheden hebben op andere gebieden? Wat voor moeilijkheden?

Wat wordt voor nazorg op het gebied van voeding en beweging wordt er momenteel aan patiënten geleverd?

Wat wordt voor verdere nazorg wordt er momenteel aan patiënten geleverd?

Wat zijn de gemiddelde standaarden qua voeding en beweging van een persoon na een bariatrische operatie?

- Aantal eetmomenten
- Calorieën / hoeveelheden
- Variatie
- Aantal minuten beweging

Denkt u dat patiënten behoefte zullen hebben aan een app of website speciaal gericht op bariatrische patiënten?

Heeft u wel eens apps of websites voor voeding en beweging aanbevolen aan bariatrische patiënten?

Als u vrij mag nadenken, wat zou een app of website volgens u moeten kunnen of bieden?

Tijdens het laten zien van VitalinQ:
Wat is uw algehele indruk van de app?

Wat vind u van de vormgeving van de app?

Zou u naar aanleiding van wat u nu hebt gezien de app aanraden bij de patiënten?

Wat vind u van de recepten optie?

- Hoe zou u dit anders doen?

Wat vind u van de voedingsdagboek optie?

- Hoe zou u dit anders doen?
- Hoe zouden we feedback kunnen geven op basis van ingevoerde data?
- Wat vind u van de huidige eetmomenten?

Wat vind u van de challenges waar patiënten uit kunnen kiezen?

- Hoe zou u de challenges aanpassen?
- Kunt u verder nog challenges bedenken die de app zou moeten bieden?
- Denkt u

Wat zijn volgens u goede richtlijnen voor calorieën / hoeveelheden / variatie / minuten beweging.

Zijn er onderdelen die u mist in de app?

Zijn er overbodige onderdelen in de app?

Appendix D

Interview guide B-participants – telephonic interview

Demografische gegevens:

- Leeftijd
- Datum operatie
- Relatiestatus/woonsituatie
- Opleiding
- Werk

Problemen na de operatie:

Hoe heeft u de periode na de operatie ervaren? Wat was lastig?

Heeft u problemen ondervonden op het gebied van eten/drinken?

Heeft u problemen ondervonden met het aanpassen van uw levensstijl na uw operatie?

Heeft u problemen ondervonden op andere vlakken? (mentaal, sociaal)

Behoefte aan ondersteuning:

Heeft u behoefte gehad aan ondersteuning na uw operatie?

- Wat heeft u gemist aan ondersteuning?
- Ondersteuning op gebied van voeding of beweging?
- Ondersteuning op andere gebieden?

Heeft u andere apps gebruikt? Wat vond u hier handig aan?

VitalinQ:

Wat is op het eerste gezicht uw algehele indruk van de app?
0 = zeer slecht – 10 = zeer goed

- Kunt u uitleggen waarom u dit cijfer geeft?

Hoe aantrekkelijk vond u de app er uitzien?
0 = helemaal niet aantrekkelijk – 10 = heel erg aantrekkelijk

- Wat vond u van de plaatjes?

Vond u de app makkelijk te gebruiken? (Hoe gebruiksvriendelijk vond u de app?)
0 = helemaal niet makkelijk/gebruiksvriendelijk – 10 = zeer makkelijk/gebruiksvriendelijk

- Kunt u uitleggen waarom u dit cijfer geeft?

Heeft de app u geholpen op het gebied van voeding?
0 = helemaal niet geholpen – 10 = zeer veel geholpen

- Waardoor kwam dit wel/ niet?

Heeft de app u geholpen op het gebied van beweging?
0 = helemaal niet geholpen – 10 = zeer veel geholpen

- Waardoor kwam dit wel/ niet?

Heeft u iets anders geleerd door de app te gebruiken?

Opdracht 1:
Heeft u een recept van de app uitgeprobeerd?
Wat vind u van deze receptenmogelijkheden van de app?
0 = helemaal niet handig – 10 = zeer handig

- Kunt u hier meer over vertellen?
- Wat zou u anders doen?
- Wat zou u graag willen zien waardoor u er zeker gebruik van gaat maken?

Opdracht 2:
Heeft u één het voedingsdagboek bijgehouden en een of meerdere dagen zelf ingevoerd wat u heeft gegeten en hiervan de voedingswaarden bekeken?
Zo ja:

- Wat vond u van deze functie?
- Wat denkt u dat er anders/beter kan aan de huidige functie?
- Wat vond u van de manier waarop nu feedback werd gegeven/ wat zou u anders willen?
- Heeft u/ zou u door het bijhouden van uw voeding, drinken en/of stappen extra inzicht gekregen in uw levensstijl?
  Zo ja: hoe kwam dat?
- Zou u/ heeft u door het bijhouden van uw voeding, drinken en/of stappen extra gemotiveerd worden om gezond gedrag te vertonen?
  Zo ja, hoe zou dat komen?

Zo nee:
De eerste functie van de app is dat u een soort van eetdagboek bij kan houden. Hierin kunt u per eetmoment invoeren wat u heeft gegeten. Er zijn nu 6 eetmomenten met een vast tijdsstip dat u kunt invullen. Aan het eind van de dag kunt u hier dan uw voedingswaarden van bekijken, bijvoorbeeld uw eiwitten. Er komt dan te staan welke voedingswaarden u te weinig, voldoende of juist teveel hebt binnen gekregen.

- Zou u hier gebruik van maken?
- Op welke manier zou u feedback willen krijgen op uw ingevulde gegevens?
- Zou u ook uw drinken willen bijhouden?
- Zou u/ heeft u door het bijhouden van uw voeding, drinken en/of stappen extra gemotiveerd worden om gezond gedrag te vertonen?
  Zo ja, hoe zou dat komen?

Opdracht 3:
Heeft u een challenge (uitdaging) gekozen?
Zo ja:

- Wat vond u van de challenges?
- Zou u zelf gebruik maken van de challenges/ Zouden zulke challenges u kunnen helpen bij het bereiken van uw doelen?
- Als u vrij mag nadenken, hoe zou u de challenges aanpassen / Welke challenges zou u toevoegen?
- Op wat voor manier wilt u hier feedback over ontvangen, zoals wanneer u een doel wel of niet gehaald hebt.

Zo nee:
Er zijn bepaalde doelen die je kan kiezen in de app. Drinken (2L per dag), groente (250g), fruit (200g), en stappen (10.000).

- Zou u hier gebruik van maken?
- Als u vrij mag nadenken, hoe zou u de challenges aanpassen / Welke challenges zou u toevoegen?
- Op wat voor manier wilt u hier feedback over ontvangen, zoals wanneer u een doel wel of niet gehaald hebt

Opdracht 4:
Wat voor functies mist u in de huidige app of wat zou u verder nog toevoegen in een toekomstige app?

- Hoe zou u de app aanpassen?
- Wat zou de app verder moeten bevatten om het in de toekomst zeer zeker te gaan gebruiken?

Opdracht 5:
Kunt u enkele positieve en negatieve aspecten van de app benoemen?

- Zaten er functies in die u absoluut zou gebruiken?
- Zaten er functies in die u absoluut niet zou gebruiken?

Algemene indruk VitalinQ:
Net Promotor Scale (NPS): Op een schaal van 0 tot 10, hoe waarschijnlijk is het dat u de huidige VitalinQ app zou aanraden aan iemand die net als u ook een bariatrische operatie heeft ondergaan?
0 = helemaal niet waarschijnlijk – 10 = zeer waarschijnlijk

Op een schaal van 0 tot 10, hoe waarschijnlijk is het dat u de VitalinQ app in de toekomst vaker gaat gebruiken?
0 = helemaal niet waarschijnlijk – 10 = zeer waarschijnlijk

Op een schaal van 0 tot 10, zou u gebruik maken van een app of internet website als deze volledig aangepast zou zijn voor bariatrische patiënten?
0 = helemaal geen gebruik van maken – 10 = zeer zeker gebruik van maken
Waarom wel/ niet?