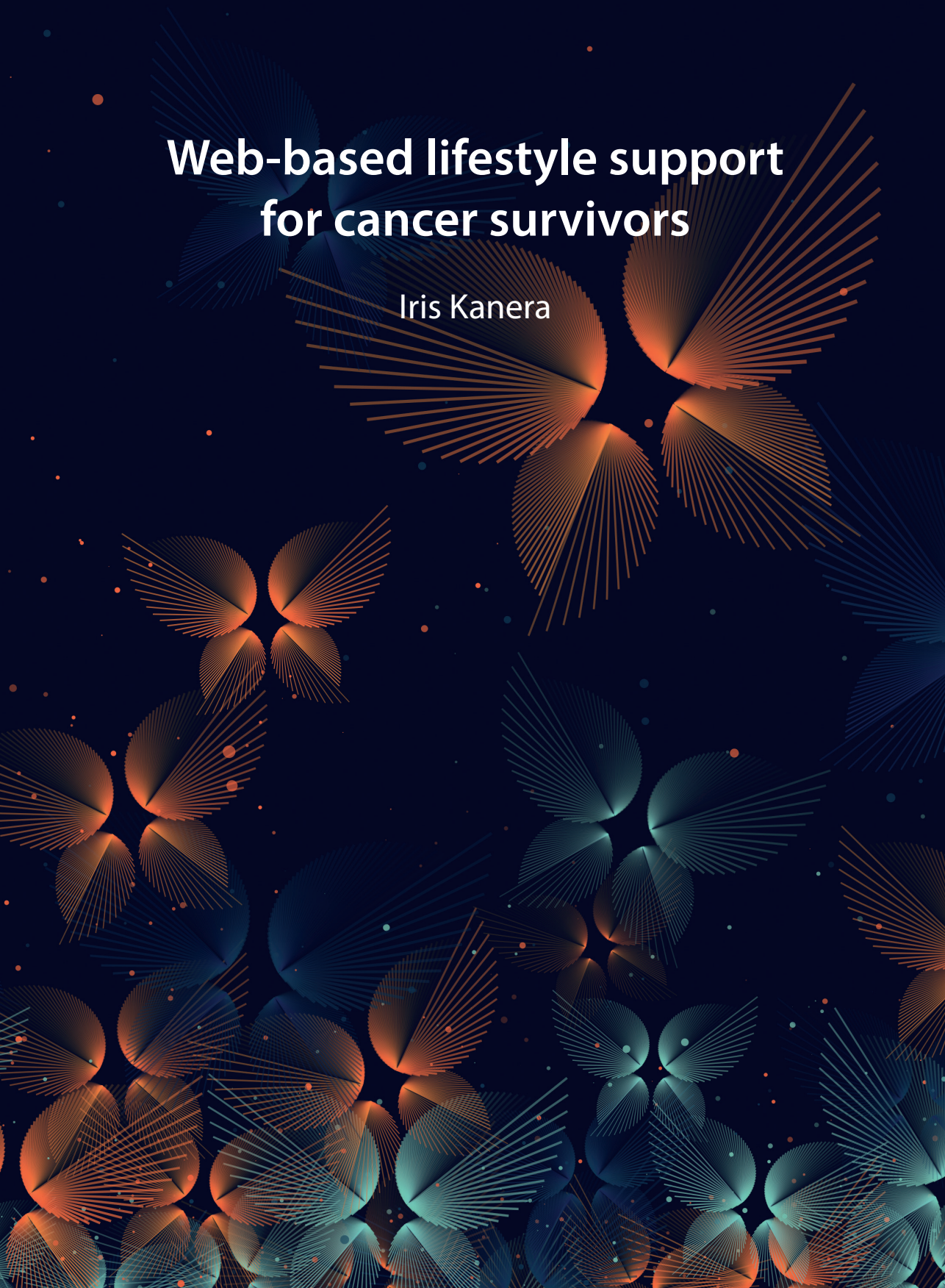
Web-based lifestyle support for cancer survivors

Iris Kanera



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GENERAL INTRODUCTION

Cancer survivorship

Cancer represents a big health problem and has a major impact on society. In 2012, 14 million new cases were registered worldwide and it is expected that the number of annual cancer cases will rise to 22 million within the next two decades due to growth and an aging population (DeSantis et al., 2014; The Netherlands Cancer Registry, 2017; Siegel, Miller, & Jemal, 2016). In the Netherlands, the number of new cancer cases increased from 70,608 in 2000 to 108,400 cases in 2016. For Dutch women, the five most common cancers in 2016 were breast (28.1%), skin (14.8%), colon (12.8%), lung (10.4%), and lymphoma and leukemia (7.4%), and among Dutch men, prostate (19.5%), colon (15.5%), skin (14.4%), lung (12.0%), and lymphoma and leukemia (9.3%) are most common (8.9%; The Netherlands Cancer Registry, 2017).

Cancer is one of the leading causes of death among the aging population. Fortunately, in recent years, early detection, and treatment improved. In the Netherlands, five-year survival is steadily increasing for all cancers (1994: 51%; 2012: 62%; Meulepas & Kiemeney, 2011; The Netherlands Cancer Registry, 2017). As a result, the number of Dutch cancer survivors increased from 370,000 in 2000 to around 700,000 in 2015 (The Netherlands Cancer Registry, 2017). Cancer survivorship can be defined as the health and life of an individual with cancer post treatment until the end of life (Mayer, Nasso, & Earp, 2017). It covers physical and psychosocial issues of cancer, beyond the diagnosis and treatment.

Challenges after cancer treatment

Having cancer is a life-threatening event that generates physical and psychosocial distress, possibly resulting in symptoms of anxiety and depression (Jensen et al., 2017; Ng et al., 2017). During curative primary cancer treatment, such as surgery, chemotherapy, and/or radiation therapy, cancer patients are engaged in an intensive medical treatment program that might cause traumatic or toxic tissue damage. After treatment completion, coping with possible residual problems of cancer and its treatment can be a great challenge (Corner, Wagland, Glaser, & Richards, 2013; Given & Given, 2013). Cancer survivors report high levels of psychosocial problems in the first year after treatment completion, such as fear of cancer recurrence, depressive symptoms, fatigue, pain, sleep disruptions, post-traumatic stress, cognitive impairments, and problems with work participation that gradually decrease within the first two years after treatment completion (Given & Given, 2013; Hinnen et al., 2008; Runowicz et al., 2016; Stanton, Rowland, & Ganz, 2015). Dependent on type of cancer and type of treatment, more specific physical residual complaints might occur. For example, after breast cancer surgery, about 20% suffer from arm lymphedema, and 25-60% of breast cancer survivors develop chronic pain. Among colorectal and prostate cancer survivors,

a considerable proportion of individuals suffer from bowel complications, incontinence, and sexual problems (Capogrosso, Salonia, Briganti, & Montorsi, 2016; DeSantis et al., 2014; Stanton et al., 2015). These problems can persist for months or years, may be associated with disability and health care utilization, and can have a profound negative impact on survivors' quality of life (QoL; Aaronson et al., 2014; Harrington, Hansen, Moskowitz, Todd, & Feuerstein, 2010; Wu & Harden, 2015). Furthermore, cancer survivors are at higher risk for cancer recurrence and comorbid conditions such as cardiovascular dysfunctions, chronic obstructive pulmonary disease, osteoporosis, and diabetes mellitus type 2 (Carmack, Basen-Engquist, & Gritz, 2011; Davies, Batehup, & Thomas, 2011; Florou, Gkiozos, Tsagouli, Souliotis, & Syrigos, 2014; Schmid & Leitzmann, 2014; Sehl, Lu, Silliman, & Ganz, 2013; Tsilidis et al., 2016). Research has shown that survivors who smoke, who are physically inactive, who have an unhealthy diet, and who are overweight, are at increased risk for morbidity, disability, mortality, and lower QoL (Carmack et al., 2011; Davies et al., 2011; Florou et al., 2014; Schmid & Leitzmann, 2014; Sehl et al., 2013; Tsilidis et al., 2016). Therefore, a healthy lifestyle is of major importance to prevent negative health outcomes and to cope with possible physical residual problems. Lifestyle in cancer survivors, more specifically healthy lifestyle promotion by an eHealth intervention is the focus of this thesis for which the rational will be explained in this introduction.

What to expect from a healthy lifestyle during cancer survivorship

Adopting and maintaining a healthy and active lifestyle is highly beneficial to reduce the risk of morbidity and mortality, and to improve QoL among cancer survivors (Husson, Mols, Ezendam, Schep, & van de Poll-Franse, 2015; Inoue-Choi, Robien, & Lazovich, 2013; Koutoukidis, Knobf, & Lanceley, 2015; Schlesinger et al., 2014; Sehl et al., 2013). For example, physical activity (PA) has been consistently associated with improved physical functioning, cardiorespiratory fitness, bodily strength, body composition, fatigue, psychological outcomes, and improved QoL in cancer survivors (Fong et al., 2012; Mishra, Scherer, Snyder, Geigle, & Gotay, 2014; Santa Mina et al., 2014; Van Dijck, Nelissen, Verbelen, Tjalma, & Gebruers, 2016). Moreover, a healthy diet is associated with healthy body weight and positive health outcomes, for example, higher vegetable consumption was associated with lower risk of cancer recurrence (Davies et al., 2011; Thomson et al., 2011). A study among persistently fatigued breast cancer survivors demonstrated that a diet rich in fruits, vegetables, whole grains, and omega-3 fatty acid-rich foods can decrease fatigue and improve sleep quality (Zick et al., 2017). In addition, smoking cessation after a cancer diagnosis was related to better performance status, a decreased risk of comorbidities, and a higher QoL (Florou et al., 2014). A recent review emphasized the effects of the inter-relationship between modifiable behavioral factors on survival and recurrence, and recommended integrating these factors in future studies (Brenner et al., 2016). In conclusion, the promotion of a physically active

lifestyle, a healthy diet, and refraining from smoking is of high importance. Therefore, the World Cancer Research Fund / American Institute for Cancer Research (WCRF/AICR) and the American Cancer Society (ACS) developed comprehensive lifestyle recommendations for the prevention of cancer and for cancer survivors (Box 1.1; World Cancer Research Fund, 2009; Rock et al., 2012). The WCRF/AICR recommendations and the Dutch guidelines overlap in their recommendations on the minimum consumption of vegetables and fruit (200 g vegetables and 2 servings [200 g] of fruit), fibers, sodium, and alcoholic beverages. The WCRF/AICR recommendations additionally include recommendations on restricting meat products, and foods and drinks that promote weight gain. In the Netherlands, the Dutch oncology standard of care (Visserman, Gijsen, & Blaauwbroek, 2014) refers to the generic PA and dietary recommendations for cancer survivors as described by the World Cancer Research Fund and refers in addition to more tailored recommendations for specific target groups (e.g., undernourished; Kampman, Beijer, & van Veen, 2013).

Box 1.1 Physical activity and nutrition guidelines for cancer survivors

Engage in regular physical activity as part of everyday life
- Be moderately physically active (for example, brisk walking) at least 150 minutes per week, spread over at least 5 days a week
- Include strength training exercises at least 2 days a week
- Limit sedentary behavior such as sitting, lying down, watching television, or other forms of screen-based entertainment
Eat mostly foods of plant origin
- Eat at least five servings (at least 400 g) of a variety of non-starchy vegetables and fruits of different colors including red, green, yellow, white, purple, and orange, including tomato-based products and allium vegetables such as garlic every day
- Eat unprocessed cereals (grains) and/or pulses (legumes) with every meal. Choose whole grains instead of refined grain products
- Avoid high-calorie foods and sugary drinks
- People who eat red meat[1]: consume less than 500 g a week, very little if any processed meat[2]
- Limit consumption of processed foods with added salt to ensure an intake of less than 6 g (2.4 g sodium) a day
Limit intake of alcoholic drinks
- Do not drink alcohol. If you do, limit alcoholic drinks to no more than one drink per day for women or two per day for men.
Be as lean as possible without being underweight
- Achieve and maintain body weight within the normal range

Note: Adapted from Nutrition and Physical Activity Guidelines from the WCRF/AICR and ACS (World Cancer Research Fund, 2009; Rock et al., 2012).

[1]beef, pork, lamb, and goat from domesticated animals including processed foods

[2]meat preserved by smoking, curing or salting, or addition of chemical preservatives, including processed foods

Lifestyle behavior among cancer survivors

Research has shown that cancer survivors did not follow consistently the lifestyle recommendations. Among Dutch colorectal cancer survivors, only 9% adhered to the fruit- and vegetable recommendations, 74% adhered to the PA recommendation, and 74% adhered to the alcohol recommendations (Winkels et al., 2016). Prior international research reported that more than half of cancer survivors were overweight, less than half followed the PA recommendations, only a minority adhered to the fruit and vegetable recommendations, while the majority did adhere to the alcohol and smoking recommendations (Bellizzi, Rowland, Jeffery, & McNeel, 2005; LeMasters, Madhavan, Sambamoorthi, & Kurian, 2014). Several studies concluded that survivors of various types of cancer were not more likely to adhere to the lifestyle recommendations as compared to the general population (Bellizzi et al., 2005; Blanchard, Courneya, Stein, & American Cancer Society's SCS-II, 2008; Coups & Ostroff, 2005; DeNysschen et al., 2015; Inoue-Choi et al., 2013; LeMasters et al., 2014; Ramaswamy, Toll, Chagpar, & Judson, 2016; Stevinson, Lydon, & Amir, 2014; Westmaas, Alcaraz, Berg, & Stein, 2014). In contrast, recent evidence did find higher rates of inactive and overweight individuals, and a lower number of heavy drinkers among cancer survivors compared to individuals with no history of cancer (Mowls, Brame, Martinez, & Beebe, 2016). Specific subgroups of cancer survivors might be more at risk to maintain unhealthy lifestyle behaviors. Individuals with a younger age, female gender, lower education, lower income, high-risk alcohol consumption, a body mass index (BMI) > 25, and having household members who smoke are more likely to maintain smoking (Kim, Kim, Park, Shin, & Song, 2015; Westmaas et al., 2014). Moreover, among cervical cancer survivors, individuals who were currently employed and had a higher income were more likely to have lower levels of PA (Park et al., 2016). Additionally, being younger, married/cohabiting, and higher educated was correlated with less alcohol consumption (Park et al., 2016). Among breast cancer survivors, individuals with a higher age and higher education were more likely to be engaged in more PA, and a healthy diet, including less alcohol consumption (George et al., 2011). Interestingly, recent findings demonstrated that cancer patients were more likely to adhere to diet and smoking recommendations just after cancer diagnosis. This suggests that a cancer diagnosis might serve as a teachable moment in which individuals are triggered and motivated to perform healthy behaviors (Bluethmann et al., 2015; LeMasters et al., 2014; Westmaas et al., 2015; Winkels et al., 2016). Nevertheless, a cancer diagnosis as the only trigger seems to be insufficient to change health behaviors in the long term. Researchers suggest that behavioral support is needed to achieve sustainable lifestyle changes (Mowls et al., 2016; Williams, Steptoe, & Wardle, 2013). This is confirmed by Charlier et al. (2012), reporting that more than half of breast cancer survivors surveyed reported a supportive care need for performing PA. Therefore, the greatest benefits of lifestyle interventions may be achieved during the early stages of survivorship when survivors might be most receptive

to interventions (Coups & Ostroff, 2005). As a first step for intervention development, a systematic assessment is needed to get insights into cancer survivors' behavioral risk factors related to lifestyle behaviors such as PA, a healthy diet, and refraining from smoking. The current state of knowledge on lifestyle determinants of cancer survivors is outlined in the next section.

Determinants of lifestyle behavior

It is important to identify factors that determine health behaviors in order to change them. Several barriers were reported by cancer survivors regarding adopting and maintaining a physically active and healthy lifestyle. These factors were residual symptoms such as pain, fatigue, physical limitations, and negative emotions, as well as insufficient knowledge of guidelines, poor motivation, lack of willpower, insufficient support from health professionals, and social and environmental barriers (Bluethmann et al., 2015; Maxwell-Smith, Zeps, Hagger, Platell, & Hardcastle, 2016; Wu et al., 2015). Moreover, cancer survivors' knowledge about healthy lifestyle issues might be low and they might not be aware of their own lifestyle risk and therefore have no intention to change (Hawkins, Berkowitz, & Rodriguez, 2015; Niu et al., 2015; Weinstein & Sandman, 1992; Winkels et al., 2016). Prior research identified that cancer survivors experience unmet information needs concerning support for lifestyle behavior changes, such as the provision of evidence-based information regarding diet, PA, and weight management as well as informational and practical support for resuming daily activities and work (Boyes, Girgis, D'Este, & Zucca, 2012; James-Martin, Koczwara, Smith, & Miller, 2014; Kwok, Palermo, & Boltong, 2015; Pullar, Chisholm, & Jackson, 2012).

Theories, such as the Social Cognitive Theory (Bandura, 2004), the Reasoned Action Approach (Ajzen, 2011; Fishbein & Ajzen, 2010), and the Attitude-Social Influence-Efficacy (ASE) model (De Vries, Mudde, Dijkstra, & Willemsen, 1998) propose explanations why individuals engage or do not engage in lifestyle behaviors by describing determinants of lifestyle behaviors. Determinants are modifiable influential factors that are specific to behavior, population, and context (Kok et al., 2015). For example, the determinant attitude comprises thoughts about the advantages and disadvantages of a specific behavior. The determinant social influence includes perceived expectations and support from important persons, and the determinant self-efficacy concerns thoughts about the perceived ability and control to perform a specific action. Determinants such as self-efficacy, attitude and social influence have been targeted in lifestyle behavior interventions for cancer survivors, and they were associated with PA and dietary changes (Green, Steinnagel, Morris, & Laakso, 2014; Stacey, James, Chapman, & Lubans, 2016). Determinants of different lifestyle behaviors among cancer survivors require further study. It should be investigated whether different lifestyle behaviors are driven by the same determinants as well as whether the behaviors are interrelated (Kampshoff et al., 2014; Koutoukidis, Beeken, Lopes, Knobf, & Lanceley, 2016; Westmaas et al., 2014).

Behavior change methods

When developing interventions to change behavior, methods for behavior change need to be applied to change the determinants of the specific behavior. The Intervention Mapping taxonomy of behavior change methods provides a toolbox to select adequate methods during intervention development (Kok et al., 2015). In addition to the previously described behavior explanation models, health behavior change is a dynamic process with a series of awareness, intention, initiation, routinizing, and maintenance phases. This process is influenced by pre-motivational determinants (e.g., knowledge, risk perception, awareness), motivational determinants (e.g., intention, attitude, self-efficacy, social influences), and post motivational determinants (e.g., ability to prepare and execute plans to achieve goals and to overcome potential barriers; Bolman et al., 2015; de Vries, Eggers, & Bolman, 2013; Sniehotta et al., 2005). Behavior change methods such as personalized feedback and consciousness-raising can be used to increase awareness and risk perception. Moreover, methods such as elaboration and arguments can be applied to change attitudes and to provide personally relevant information (Abraham & Michie, 2008; Kok et al., 2015). Modeling can be used to reinforce the desired action by targeting for instance abilities and self-efficacy. Furthermore, goal setting, action planning, coping planning, and self-monitoring can change and maintain the new behavior (Bolman et al., 2015; Kok et al., 2015). A theoretical framework is needed to explain how the mechanisms of behavior change work and why relationships between behavior change methods and behavior change can be expected (Kok et al., 2015). Possible theories that explain health behavior change and provide suggestions for behavior change methods include the Transtheoretical Model (Prochaska & DiClemente, 1983), the Precaution Adoption Model (Weinstein & Sandman, 1992), the Relapse Prevention Theory (Larimer, Palmer, & Marlatt, 1999; Marlatt & Gordon, 1985), the Self-Regulation Theory (Baumeister, Heatherton, & Tice, 1994), and the Integrated Model for Change (I-Change Model; de Vries et al., 2003). In addition, principles of Problem-Solving Therapy (PST; D'Zurilla & Nezu, 2007) and Cognitive Behavioral Therapy (CBT; Bleijenberget al., 2007) can provide behavior change methods and practical applications to increase adequate self-management that is defined as "the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences and lifestyle changes inherent in living with a chronic condition. Efficacious self-management encompasses ability to monitor one's condition and to effect the cognitive, behavioral and emotional responses necessary to maintain a satisfactory quality of life. Thus, a dynamic and continuous process of self-regulation is established" (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002). PST includes emphasis on determinants such as a positive attitude towards facing the problem, and strategies such as identifying the problem, exploring alternatives, setting goals, and planning, performing, and evaluating specific actions. Useful methods to enhance self-management provided within CBT can be monitoring behavior and/or thoughts, challenging dysfunctional cognitions, and

encouragement to set (new) goals. Prior research demonstrated that CBT is an effective therapy for insomnia among breast cancer survivors, by improving mood, fatigue, and global and cognitive dimensions of QoL (Arico, Raggi, & Ferri, 2016).

It is possible to address a large audience personally without causing high costs. Tailoring is a proven effective method to personalize information and support within health communication by matching intervention components to previously measured characteristics of the individual (De Nooijer, Lechner, & de Vries, 2002; de Vries & Brug, 1999; de Vries, Kremers, Smeets, Brug, & Eijmael, 2008; Noar, Benac, & Harris, 2007; Oenema, Brug, Dijkstra, de Weerdt, & de Vries, 2008; Stanczyk, de Vries, Candel, Muris, & Bolman, 2016). By using an (online) questionnaire, specific characteristics of the target group are gathered, including demographic characteristics, current behavior, but also aspects such as knowledge, social influences, attitudes, and self-efficacy. Subsequently, messages can be designed and adapted to the participants' characteristics. As a result, personalized feedback can be generated while redundant information can be avoided (de Vries & Brug, 1999). In fully automated eHealth interventions, the specific responses of the participants are automatically selected and combined with the appropriate message from a pre-programmed message library. Therefore, specific decision rules and algorithms need to be predefined. An advantage of fully automated online interventions is that tailored feedback can be displayed immediately after completing the online assessment. The tailoring variables should be based on a behavioral theory and related to behavior change or to other relevant factors, such as socio-demographic and cancer-related factors (Kok et al., 2015; Noar et al., 2007). Effective health behavior interventions among the general population included advice that was tailored to the current behavior, personal and psychological characteristics, concepts such as risk perception, attitudes, self-efficacy, stage of change, processes of change, and social influences (Noar et al., 2007; Peels et al., 2012; Springvloet, Lechner, de Vries, Candel, & Oenema, 2015; Stanczyk et al., 2014; van Keulen et al., 2010; Walthouwer, Oenema, Soetens, Lechner, & de Vries, 2013). Moreover, by assessing the current behavior and relevant determinants at different time points, participants can receive personalized, possibly varying feedback at different moments in time. This thesis describes how relevant behavior change methods were applied in a fully automated eHealth intervention in order to change relevant determinants of cancer survivors' lifestyle behaviors to contribute to the optimization of cancer aftercare.

Cancer aftercare and the promotion of a healthy lifestyle

As previously outlined, the growing number of cancer survivors living longer will be at risk of (long-term) physical and psychosocial residual problems, as well as developing new cancers. Moreover, survivors are in need of support to manage these problems, and to (re) gain a healthy lifestyle balance. Consequently, current cancer aftercare does not match the

growing demand, which puts growing pressure on health care systems (Mayer et al., 2017). In 2007, the Health Council of the Netherlands concluded that aftercare for cancer survivors was insufficient in the Netherlands. Therefore, the Netherlands Comprehensive Cancer Organization (Integraal Kankercentrum Nederland) developed the guideline "Recovery from Cancer" (Herstel na Kanker; Comprehensive Cancer Centre the Netherlands, 2011b). This guideline provides a broad programmatic approach for oncology aftercare. Greater attention should be paid to the early recognition of survivors' psychosocial and lifestyle risks and needs during recovery and early cancer survivorship while self-management should be stimulated. It advises developing and implementing an individual survivorship care plan for each cancer patient/survivor (Aaronson et al., 2014; Comprehensive Cancer Centre the Netherlands, 2011b; Given & Given, 2013; Stanton et al., 2015).

Implementing these guidelines into the care system is complex. The provision of appropriate information and gaining access to adequate psychosocial care and lifestyle support is challenging in the often very busy oncology settings (Krebber et al., 2012). Besides restricted time, health professionals also perceive a lack of knowledge and counseling skills to promote and support self-management and health behavior change (Anderson, Caswell, Wells, & Steele, 2013; Coa et al., 2015). Moreover, cancer survivors might also be reluctant to be referred to traditional forms of aftercare as described in the guideline for cancer rehabilitation, as these might not meet their current need (Comprehensive Cancer Centre the Netherlands, 2011a). Generally, referral rates to physical, psychosocial, and/or lifestyle support appeared to be low, while many cancer survivors experience unmet needs (Aaronson et al., 2014). Therefore, the guideline Recovery from Cancer recommends setting up a custom-made supportive care plan and to apply a stepped care approach as an alternative care delivery system to provide more efficient and personalized aftercare (Krebber et al., 2012). In stepped care, a series of four steps are involved: (1) watchful waiting, (2) guided self-help, and other brief therapies, followed by (3) face-to-face problem solving treatments, and (4) other specialized interventions that are more intensive. In the first steps, a low intensive support might be sufficient to meet the personal needs of a large proportion of cancer survivors with relatively mild complaints and manageable needs of perceived limited complexity. Guidance during the first two steps includes a low intensive provision of information that mainly facilitates self-care, such as survivors' active participation in defining possible problem areas, setting goals, and making a personal action plan to address manageable problems. The more intensive interventions (e.g., face-to-face PST) are reserved for smaller proportions of cancer survivors with more intensive or complex care demands, who do not benefit sufficiently from low intensive interventions (Aaronson et al., 2014; Krebber et al., 2012). This thesis focusses on the development and evaluation of a low intensive self-management intervention for cancer survivors.

eHealth as a source of guided self-help in cancer aftercare

Since cancer survivors are very interested in information about cancer-related topics, an increasing number use the Internet as a source for cancer-related information (Chou, Liu, Post, & Hesse, 2011; Shea-Budgell, Kostaras, Myhill, & Hagen, 2014). However, public websites that offer generic cancer-related information may be incomplete and unable to give individualized patient-specific support (Shea-Budgell et al., 2014; Warren, Footman, Tinelli, McKee, & Knai, 2014). Moreover, cancer survivors consider the doctor or health professional as the most trusted source of cancer-related information. Among oncology care providers, there is a growing interest in web-based interventions as a means of supportive care, given the numerous advantages of web-based interventions (Chou et al., 2011). Evidence-based web-based interventions can provide reliable cancer aftercare support that can complement face-to-face counseling and may fill an important gap in current cancer aftercare by providing easily accessible information and supporting self-care (Leykin et al., 2012). Web-based interventions potentially have a high reach, can reduce treatment time and costs, and can comprise comprehensive and relevant self-management support in a structured and interactive way, enhanced by video, graphics, animations, and hyperlinks, while personalization is also possible by applying computer tailoring (Broekhuizen, Kroeze, van Poppel, Oenema, & Brug, 2012; Noar et al., 2007; Winkels et al., 2016). Additionally, a considerable advantage of eHealth interventions is that treatment becomes available at any time anywhere, and anonymity can be preserved. Web-based interventions that engage survivors more actively and stimulate self-management might be integrated into a stepped care approach, for example as guided self-help. In this approach, cancer survivors could be referred by an oncology professional to a trusted patient self-help portal with secure access (Shea-Budgell et al., 2014). However, it should be noted that not all cancer survivors have the same level of computer skills. In the Netherlands, the proportion of households with Internet access is high (94 %), and from the individuals aged between 45-65 years, about 70% have at least basic computer skills. However, the number of persons with basic computer skills is lower among older (about 30%) and among lower educated individuals (about 50%; Statistics Netherlands, 2016). It can be expected that in the years ahead, the future elderly will increasingly be accustomed to computer programs, and operating computers probably will become easier. However, in the present time, online interventions for an older target population should be as easy as possible. Some eHealth programs have already been developed and tested for cancer survivors that will be described in the following paragraph.

Overview of web-based interventions for cancer survivors

In the current and past decades, an increasing number of Internet initiatives for cancer patients and survivors have been developed, such as patient platforms, educational programs, and interventions that link patients with their healthcare professional online.

Most of the online programs focused on dealing with psychosocial issues. Kim and Park (2015) included 37 studies regarding web-based self-management interventions for cancer survivors between 2000 to 2014 in their recent review, and they reported that more than half of these studies were published in 2013 and 2014. Overall, the reported effects across all outcome measures such as fatigue, depression, anxiety, and QoL were small to moderate compared to usual care. Another recent review among cancer patients revealed only few rigorously evaluated online interventions reporting mixed effects on QoL and related measures, which indicates that the effectiveness of web-based interventions to achieve increases in QoL remains unclear (McAlpine, Joubert, Martin-Sanchez, Merolli, & Drummond, 2014). Only a few studies investigated the effect of web-based interventions for cancer survivors aimed at lifestyle behavior outcomes. These studies reported that web-based interventions could be effective among cancer survivors to change PA and diet outcomes (Goode, Lawler, Brakenridge, Reeves, & Eakin, 2015; Kuijpers, Groen, Aaronson, & van Harten, 2013; Short et al., 2016). The included behavior change methods were tailored feedback, education, self-monitoring, self-management training, personal exercise programs, and communication (e.g., chat, email) with either health care providers or fellow survivors, and links to other websites. Moreover, a web-based version of a smoking cessation intervention for cancer survivors achieved similar cessation rates compared to the original telephone-delivered intervention, which is in line with the significant effects of web-based smoking cessation interventions for the general population (Emmons et al., 2013; Graham et al., 2016). Specifically, the number of published multi-behavior interventions that target psychosocial as well as lifestyle issues for cancer survivors is very scares and included relatively short follow-up periods (Bantum et al., 2014; Lee et al., 2014). These latter studies showed increases in PA and mixed results in diet change. The behavior change methods in these multi-behavior interventions included problem solving, action planning, decision-making, and computer tailoring. In sum, insight into the effects on lifestyle-related outcomes of web-based interventions for cancer survivors is still very limited, although promising. Given the growing demand for cancer aftercare and the potential of web-based interventions, it was considered useful to develop and evaluate a fully automated, comprehensive web-based cancer aftercare intervention, the Cancer Aftercare Guide (Kanker Nazorg Wijzer, KNW).

The research project Kanker Nazorg Wijzer (Cancer Aftercare Guide)

The present thesis is part of a larger research project. The research project aimed to develop and evaluate a web-based computer-tailored intervention for cancer survivors that fit well with the guideline Recovery from Cancer of the Netherlands Comprehensive Cancer Organisation (2011b). The new program should provide an assessment of needs and risks, and subsequent support for cancer survivors in learning to cope with difficulties and challenges they face after primary treatment completion. The present Ph.D. thesis

focuses mainly on lifestyle-related topics, and another Ph.D. thesis by Willems (2017), addresses mainly psychosocial issues, like fatigue, anxiety, and depression. The rationale behind the web-based program was to help cancer survivors to 1) become aware of health risk behaviors, 2) to get motivated to change and to be able to control behaviors, 3) to initiate health enhancing behaviors and maintain the improved behaviors. The idea was to offer web-based, fully automated, easily accessible, and personalized self-management support program for a large group of cancer survivors that combines psychosocial and lifestyle issues. Such a comprehensive eHealth intervention could be integrated into an individual survivorship care plan, and could be used as one of the first steps in stepped care (guided self-help), while saving oncology care providers' time and health care costs. At the time when the project began (2012), existing public websites mainly provided general information on cancer diagnosis and treatment, but there was limited published research that evaluated web-based interventions targeting cancer survivors (Ream, Blows, Scanlon, & Richardson, 2009). Therefore, a comprehensive needs assessment was required to determine the most prevalent cancer-related problems and behavioral risks, the (unmet) information- and support needs, and moreover, to identify preferences for delivery details and lay-out of the web-based intervention. Qualitative as well as quantitative research methods were planned (systematic literature review, focus group interviews among the target group, testing findings on a large scale by conducting a survey study). Subsequently, the web-based intervention, the Kanker Nazorg Wijzer (KNW) had to be developed, and pre-tested before its implementation and broad scale evaluation among the target group. The target group consisted of adult cancer survivors (any type of cancer) in the first year after successfully completing primary cancer treatment. For the evaluation of the intervention, a two-armed randomized controlled trial (intervention group and waiting list control group) was planned. Online follow-up measurements were planned at three, six, and 12 months after the baseline assessment. It was considered useful to study how cancer survivors would use and appreciate a stand-alone online cancer aftercare intervention that addresses a broad range of topics. Furthermore, it was planned to assess short- and long-term effects of the KNW on lifestyle-related outcomes and on psychosocial outcomes.

The objectives of the present thesis were: (1) to assess the prevalence and correlates of lifestyle behaviors of cancer survivors; (2) to develop lifestyle behavior change modules for former cancer patients on PA, dietary behavior (vegetable, fruit, fish and whole grain bread consumption), and smoking, incorporated in the broader web portal; (3) to assess the use and appreciation of the KNW intervention; (4) to evaluate the effects of the KNW intervention on lifestyle-related outcomes after 6 (end of portal access) and 12 months.

AIM AND OUTLINE

Part I. Intervention development

Chapter 2 describes a particular part of the needs assessment that explores lifestyle-related details using a cross-sectional survey study. The aim of this study was to gain specific insight into cancer survivors' lifestyle behaviors in the Netherlands, the prevalence and correlates of smoking, physical activity, alcohol, and fruit and vegetable consumption, the correlations between the different lifestyle behaviors, and the correlates of adherence to lifestyle recommendations.

Chapter 3 describes the systematic development of the KNW, including detailed information and exploration of the underlying needs, program goals, performance objectives, changeable determinants, theoretical methods, intervention design, and the evaluation of the intervention.

Part II. Intervention process evaluation

Chapter 4 includes a process evaluation exploring how the intervention was used, appreciated, and whether use and appreciation were predicted by certain user characteristics. Furthermore, the adherence to an automated personalized 'Module Referral Advice' was evaluated that aimed to guide participants through the intervention. Moreover, it was investigated whether the broad content was sufficiently tailored to suit the needs of a varied population of cancer survivors.

Part III. Intervention effect evaluation

The effects of the KNW intervention on lifestyle-related outcomes were evaluated in a randomized controlled trial, six and 12 months after completing the baseline assessment. The study in **Chapter 5** describes the overall intervention effects of the KNW on vegetable, fruit, whole grain bread, and fish consumption, PA, and smoking behavior 6 months after baseline. Furthermore, the effect of using behavior-specific modules on the corresponding behavior was explored.

Chapter 6 explores whether previously determined positive changes after six months were maintained in the long term (i.e., after 12 months). In accordance with the effect evaluation after six months, the effects of using the behavior-specific modules on outcomes of the corresponding behavior were explored. To identify possible subgroups that might benefit most from the web-based KNW, we evaluated whether possible intervention effects were moderated by socio-demographic variables.

The final chapter, **Chapter 7,** summarizes and integrates the main results presented in the previous chapters, and relates them to previous conducted research. Furthermore, the main methodological considerations as well as suggestions for future research, proposals for improvement of the KNW intervention, and the implications for implementation of the KNW into clinical practice are discussed. Finally, some general conclusions are provided. An overview of the studies in this thesis is displayed in Table 1.1.

Table 1.1 Overview of the studies in this thesis

Chapter	Objectives	Design	Sample size
	Part I. Intervention development		
2	(1) To assess the prevalence of smoking, physical activity, alcohol, and fruit and vegetable consumption, and adherence to lifestyle recommendations (2) To examine the correlations between the different lifestyle behaviors (3) To explore the contribution of demographic, cancer-related, psychological and social cognitive factors to explain lifestyle behaviors and adherence to recommendations	Cross-sectional survey	*N* = 255
3	To describe the systematic development of the Kanker Nazorg Wijzer (Cancer Aftercare Guide, KNW)	NA	NA
	Part II. Intervention process evaluation		
4	(1) To describe the use of the KNW modules and to identify predictors of a higher number of modules used (2) To investigate the adherence to the Module Referral Advice (3) To describe the appreciation of the KNW at its predictors, and to explore possible predictors of personal relevance	RCT, longitudinal	*N* = 231
	Part III. Intervention effect evaluation		
5	(1) To assess the effect of the KNW on physical activity outcomes, diet outcomes, and smoking, 6 months after baseline (2) To explore the effect of using the behavior-specific module on the outcome of the corresponding behavior	RCT, longitudinal	*N* = 462
6	(1) To examine the long-term effects of the KNW on moderate physical activity and vegetable consumption, 12 months after baseline (2) To explore the effect of using the behavior-specific module on the outcome of the corresponding behavior (3) To explore whether possible effects were moderated by gender, age, and educational level	RCT, longitudinal	*N* = 462

Note: NA = Not Applicable; RCT = randomized controlled trial; KNW = Kanker Nazorg Wijzer

PART I

Intervention development

Prevalence and correlates of healthy lifestyle behaviors among early cancer survivors

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ABSTRACT

Background

Healthy lifestyle behaviors have been demonstrated to be beneficial for positive health outcomes and the quality of life in cancer survivors. However, adherence to recommendations is low. More insight is needed in factors that may explain engagement in lifestyle behaviors to develop effective cancer aftercare interventions. This study assessed different factors, namely socio-demographic, cancer-related, psychological, social cognitive factors (attitude, social support, self-efficacy) and intention, in relationship to five lifestyle behaviors (smoking, physical activity, alcohol, and fruit and vegetable consumption).

Methods

Early survivors of various types of cancer were recruited from eighteen Dutch Hospitals ($N = 255$). Distal factors (socio-demographic, cancer-related, psychological), proximal factors (social cognitive), intention and five lifestyle behaviors (smoking, physical activity, alcohol, fruit and vegetable consumption) were assessed through a self-reported questionnaire. Cross-sectional analyses (correlations and regression analyses) were conducted.

Results

The lifestyle of a small group (11%) of the cancer survivors was coherent with all five health recommendations, the majority (> 80%) adhered to two, three of four recommendations, and only few (< 7%) adhered to one or none recommendation. The highest prevalence in followed recommendations have been detected in physical activity (87.4%), refrain from smoking (82%), and alcohol consumption (75.4%). There was low adherence to the fruit recommendation (54.8%) and to the vegetable recommendation (27.4%). Only weak associations were found between the different behaviors. Each separate lifestyle behavior was influenced by different patterns of correlates. Self-efficacy, attitude, and intention were the strongest correlates in all examined behaviors, although with various contributions, while socio-demographic, cancer-related and psychological factors provided a much smaller contribution.

Conclusions

Outcomes of engagement in healthy lifestyle behaviors were more positive in this study compared to other research in cancer survivors; however, there is room for improvements in adherence to all five lifestyle behaviors. Especially fruit consumption was poor and vegetable consumption even worse. Our findings emphasized that all examined lifestyle behaviors need to be encouraged, with taken into account that each lifestyle behavior may be influenced by a specific set of mainly social cognitive factors or intention.

BACKGROUND

A healthy lifestyle is of major importance for cancer survivors, since it has been shown that adherence to an increasing number of health recommendations may lower the risk of lifestyle-related chronic diseases and may lead to a higher health-related quality of life QoL; Blanchard et al., 2008; Blanchard et al., 2004; Davies et al., 2011; Ford et al., 2009; Schlesinger et al., 2014). Moreover, unhealthy behaviors may have a negative impact on QoL and cause new health problems such as cancer recurrence, new primary tumors and other chronic diseases (Baena Ruiz & Salinas Hernandez, 2013; Colditz, Wolin, & Gehlert, 2012; Davies et al., 2011; Inoue-Choi et al., 2013; Kushi, Kwan, Lee, & Ambrosone, 2007; McLaughlin, Trentham-Dietz, Hampton, Newcomb, & Sprague, 2014; Schmid & Leitzmann, 2014). Health recommendations for cancer survivors include the following: achieve and maintain a healthy body weight (body mass index [BMI] within the range of 18.5 to 25.0 kg/m^2), engage in at least 30 minutes of moderately intense physical activity (PA) per day at five or more days weekly, eat five servings of fruit and vegetables daily, avoid or limit alcohol consumption to up to two servings per day for men and one serving per day for women, and refrain from smoking (Klosky et al., 2007; Rock et al., 2012; Wilson, Parsons, & Wakefield, 1999). Previous research suggested that adherence to PA recommendations might be the most important lifestyle behavior associated with lower mortality and higher QoL in cancer survivors (Inoue-Choi et al., 2013; Schmid & Leitzmann, 2014; Sehl et al., 2013).

Recent research showed that cancer survivors do not adhere consistently to these health recommendations. More than half is overweight, less than half adhere to PA recommendations, about only one fifths adhere to fruit en vegetable recommendations, about 90% do not smoke, and approximately 90% of cancer survivors adhere to the alcohol recommendations (Bellizzi et al., 2005; Blanchard et al., 2008; Inoue-Choi et al., 2013; LeMasters et al., 2014). Broadly, similar results were found in people without a history of cancer (Coups & Ostroff, 2005; Eakin et al., 2007; Mayer et al., 2007; Williams et al., 2013). Until now, research about the adherence to a combination of health behaviors showed mixed results: European studies report about 10%-28% of the cancer survivors followed zero or one recommendation, about one third adhered to two, and also about one third adhered to three, and about 10 - 23% adhered to four recommendations (Ford et al., 2009; Schlesinger et al., 2014). American studies reported even lower adherence scores to multiple health behaviors (Blanchard et al., 2008; Mayer et al., 2007; O'Neill et al., 2013). In comparison, research conducted in the general population among older adults indicated that most of them followed three or more lifestyle recommendations (86%; Pronk et al., 2004), suggesting less adherence among cancer survivors compared to the general population. Considering that cancer survivors are at increased risk of cancer recurrence and lifestyle-related chronic diseases, adhering to multiple lifestyle recommendations is however very important for the health related QoL of this specific group. This underlines the need to understand which

factors explain the different health behaviors and the adherence to an increasing number of lifestyle recommendations. Furthermore, possible correlations among lifestyle behaviors need to be identified to understand possible mutual influences.

As theoretical framework for our search into factors that relate to a healthy lifestyle among cancer survivors, we applied the central thoughts and concepts from social cognitive models: the Reasoned Action Approach, the Attitude-Social influence-Efficacy (ASE) model and its successor the Integrated Model for Behavior Change (I-Change-Model; de Vries et al., 2003; de Vries et al., 1998; Fishbein & Ajzen, 2010; de Vries & Mudde, 1998). These models assume that behavior can be predicted by a behavioral intention, which is influenced by proximal factors (social cognitive concepts: attitudes, perceived social influences and self-efficacy expectancies), which in turn can be influenced by more distal factors. In the current study, as distal factors we applied socio-demographic, psychological, and cancer-related factors.

In recent years, studies identified correlates of PA, however, less is known about the correlates of the other lifestyle behaviors. Regarding PA, besides cancer-related variables (fatigue, physical side effects), attitude, self-efficacy, social support and intention were important correlates in explaining PA in cancer survivors (Charlier et al., 2013; Forbes, Blanchard, Mummery, & Courneya, 2014). Additionally, exercise history could be identified as important predictor of exercise adherence. However, for intention, perceived behavior control, age, gender, education, physical fitness and psychological features the findings were inconsistent (Husebo, Dyrstad, Soreide, & Bru, 2013; Kampshoff et al., 2014). Considerably fewer publications described possible correlates of healthy diet, alcohol consumption, and smoking in cancer survivors. Madlensky et al. (2008) identified motivation and self-efficacy as strong predictors of the dietary pattern in breast cancer survivors. Current smoking in cancer survivors was correlated with younger age, lower education and income, and greater alcohol consumption, while quitting after cancer diagnosis was associated with having a smoking related type of cancer (Westmaas et al., 2014).

The aims of the present study were 1) to assess the prevalence of lifestyle behaviors and the adherence to recommendations in early cancer survivors, 2) to examine correlations between the different health behaviors and 3) to explore the contribution of socio-demographic, cancer-related, psychological features, social cognitive factors, and intention to explain lifestyle behaviors and adherence to recommendations. To our knowledge, this is the first study, exploring the combined contribution of distal factors (enclosing cancer specific socio-demographic and psychological factors), more proximal factors (such as attitude, social support, self-efficacy), and intention, derived from social cognitive models to explain five lifestyle behaviors and adherence to recommendations in early cancer survivors with various types of cancer.

METHODS

We conducted a cross-sectional survey among early cancer survivors with various types of cancer. This study was approved by the Ethics Review Board on Research (cETO) of the Open University, Heerlen, The Netherlands. This study was carried out in accordance with the American Psychological Association's Ethics Code and the Declaration of Helsinki (American Psychological Association, 2010; World Medical Association, 2013). No further approval by the Medical Research Ethics Committee (MREC) was necessary, because present study did not fall under the Medical Research Involving Human Subjects Act (WMO).

Study population

Cancer survivors from Dutch outpatient departments of internal medicine, oncology, and urology were invited to participate. Required sample size of the most extensive multiple regression analysis was $N \geq 160$. Inclusion criteria were: adults (> 18 years) diagnosed with and treated for one type of cancer with no sign of recurrence at the last control visit; surgery, chemotherapy and/or radiation therapy as primary treatment, which has been completed at least 6 weeks and up to one year ago. Cancer survivors with severe medical, psychiatric of cognitive problems that would interfere with participation were excluded from the study.

Study procedure

Eighteen hospitals in the South of the Netherlands were approached for recruitment of participants. Medical staff of eight hospitals agreed and recruited cancer survivors in the period from November 2012 until January 2013. Two recruitment strategies were used: 1) selection of cancer survivors through record review by (research) nurses or 2) personal invitations during outpatient clinic visits with oncologist, urologist, or nurse practitioner. Potentially eligible participants received an information letter, an informed consent form, and a survey booklet. A reminder letter followed 2 weeks later. Cancer survivors, who agreed to participate, were asked to provide written informed consent, to complete the questionnaires and to return these documents to the researchers in an enclosed pre-paid envelope.

Measurements

All measurements concerned self-report questionnaires.

Lifestyle outcome measures

PA was assessed using the International Physical Activity Questionnaire Short Form (IPAQ Short; Craig et al., 2003; Vandelanotte, De Bourdeaudhuij, Philippaerts, Sjöström, & Sallis,

2005); standardized questions from Dutch Measuring Instruments for Research on Smoking and Smoking Cessation were used to measure smoking behavior (Mudde, Willemsen, Kremers, & de Vries, 2006); nine items from the Dutch standard questionnaire on nutrition measurements were used to determine vegetable and fruit consumption (van den Brink, 2005; van Loon & van Veldhuizen, 2003); alcohol consumption was assessed by using four items from the Dutch standard questionnaire on alcohol consumption (van Loon & van Veldhuizen, 2003). Table 2.1 provides an overview of these measurements and their properties.

Table 2.1 Lifestyle outcome measurements

Behavior	Questionnaire / example question	Categories / scales	Items	Item-range	Score-range
Physical Activity[1]	IPAQ Short last 7 days self-administered format	Walking Moderate intensive activity Vigorous intensive activity	2 2 2		(MET-min/week)
Smoking	"Do you currently smoke?"	Current smoking behavior	1	0-1	0-1
	"Did you smoke in the past?"	History of smoking (quit smoking before / after cancer diagnosis)	1	0-1	0-1
Alcohol consumption	Dutch standard questionnaire on alcohol consumption	Number of days and glasses of alcohol on weekdays and weekends	4	0-6	0-4
		Binge drinking[2]	1	1-8	0-7
Vegetable and fruit consumption[3]	Dutch standard questionnaire on nutrition	Number of servings fruit/ vegetable (spoons, pieces, glasses) per day and number of days per week	9	1-9	0-7

Note: IPAQ Short: International Physical Activity Questionnaire Short Form; MET: Metabolic Equivalent of Task

[1] ≥ 600 MET-min/week corresponds to ≥ 5 days per week performing any combination of walking, moderate or vigorous physical activities

[2] ≥ Six servings of alcohol during one day

[3] Vegetable consumption was expressed in grams per day. The total score for fruit consumption was the number of servings of fruit per day (up to 100 grams fruit may be replaced by fruit juice)

Socio-demographic measures

Socio-demographic items were measured using standard questions on age, gender, marital status, education level (*low*: lower vocational education, medium general secondary education; *medium*: secondary vocational education, higher general secondary education; *high*: higher vocational education, university education), income level (*below average*: < €1,800 per month; *average*: > €1,800 and < €2,200 per month; *above average*: > €2,200 per month), employment status (*working*: self-employed, in paid employment; *not working*: unemployed, retired, unable to work).

Cancer-related measures

Standard questions were used to assess cancer-related factors. Type of cancer was subsequently categorized into breast, colon, and other types; because of insufficient numbers of the separate types of cancer for appropriate statistical analyses (see footnote Table 2.3). Type of treatment was categorized into surgery alone, surgery & chemotherapy, surgery & radiation, surgery, chemotherapy & radiation, and other types for the same reason. Aftercare participation was dichotomized (*yes, no*). Information on length and weight were used to calculate the body mass index (BMI).

Psychological measures

Table 2.2 provides an overview of the psychological measures and their properties. QoL was assessed by using the European Organisation for Research and Treatment of Cancer (EORTC QLQ-C 30; Aaronson et al., 1993; Fayers & Bottomley, 2002; EORTC Quality of Life Group, 2001). Anxiety and depression were measured by applying the Hospital Anxiety and Depression Scale (HADS; Bjelland, Dahl, Haug, & Neckelmann, 2002; Zigmond & Snaith, 1983). Adjustment to cancer was assessed using the Mental Adjustment to Cancer Scale (MAC; Braeken et al., 2010; Watson et al., 1988; Watson & Homewood, 2008). Illness perception was assessed with the Brief Illness Perception Questionnaire (Brief IPQ; Broadbent, Petrie, Main, & Weinman, 2006; Weinman, Petrie, Moss-Morris, & Horne, 1996). The items of the latter questionnaire were adjusted to focus on recovery from cancer, and item 4 (treatment control) was deleted to achieve an acceptable internal consistency (increase Cronbach's alpha from .61 to .75 after removing item 4). Problem solving orientation was measured by using the Short Social Problem Solving Inventory-Revised (SPSI–R: S; D'Zurilla, Nezu, & Maydeu-Olivares, 2002).

Social cognitive measures

Attitude, social support, self-efficacy, and intention for each lifestyle behavior were measured by using single items for the separate concepts consisting of 5-point scales with a score ranging from 1-5. Attitude was assessed with questions such as "Is it important for you to follow the nutrition guidelines?" Answer options were *yes, very important* (5), *yes, important* (4), *not important / not unimportant* (3), *no, not important* (2), *no, not at all important* (1). Social support was measured by asking questions such as "To what extent do you get support from people who are important to you, to exercise sufficiently?" Response options were *always* (5), *often* (4), *sometime* (3), *seldom* (2), *never* (1). Self-efficacy was assessed by asking questions such as "Is it easy or difficult for you to exercise according to the guidelines?" Answering choices were *very easy* (5), *easy* (4), *not difficult / not easy* (3), *difficult* (2) *very difficult* (1). Intention was measured by asking questions such as "Do you intend to eat 2 servings of fruit a day in the next 6 months?" Response options were *yes,*

certainly (5), *yes, probably* (4), *maybe / maybe not* (3), *no, probably not* (2), *no, certainly not* (1). Prior research also applied similar items to measure social cognitive concepts (Bakker, Nijkamp, Sloot, Berndt, & Bolman, 2015; Berndt et al., 2014; Ronda, Van Assema, & Brug, 2001; Smeets, Kremers, Brug, & de Vries, 2007; Smit, de Vries, & Hoving, 2013).

Table 2.2 Psychological outcome measures

Concept	Instrument	Subscales used	Items	Score-range	α	Higher scores indicates
Quality of life	EORTC QLQ-C30	Global health status	2	0-100	.88	Better overall health and quality of life
		Physical functioning	5	0-100	.72	Better functioning
		Role functioning	2	0-100	.86	Better functioning
		Emotional functioning	4	0-100	.86	Better functioning
		Cognitive functioning	2	0-100	.70	Better functioning
		Social functioning	2	0-100	.70	Better functioning
		Fatigue	3	0-100	.87	Higher level of problems
		Nausea and vomiting	2	0-100	.52	Higher level of problems
		Pain	2	0-100	.82	Higher level of problems
		Dyspnea	1	0-100		Higher level of problems
		Insomnia	1	0-100		Higher level of problems
		Appetite loss	1	0-100		Higher level of problems
		Constipation	1	0-100		Higher level of problems
		Diarrhea	1	0-100		Higher level of problems
		Financial difficulties	1	0-100		Higher level of problems
Anxiety, depression	HADS	Anxiety	7	0-21	.84	More morbidity
		Depression	7	0-21	.80	More morbidity
Adjustment to cancer	MAC	Positive adjustment			.78	More positive adjustment
		Fighting spirit	16	16-64		
		Avoidance	1	1-4		
		Negative adjustment			.84	More negative adjustment
		Helplessness/Hopelessness	6	6-24		
		Anxious preoccupation	9	9-36		
		Fatalism	8	8-32		
Illness perception	Brief IPQ	Consequences, Timeline, Personal control, Identity, Concern, Coherence, Emotional representation	7	0-70	.80	More threatening view of the illness
Problem solving orientation	SPSI–R: S	Positive problem orientation	5	0-4	.72	Positive outcome and self-efficacy expectancies, less emotional distress
		Negative problem orientation	5	0-4	.86	Negative outcome and self-efficacy expectancies, more emotional distress

Note: QLQ-C30: Quality of Life Questionnaire; HADS: Hospital Anxiety and Depression Scale; MAC: Mental Adjustment to Cancer Scale; Brief IPQ: Brief Illness Perception Questionnaire; SPSI–R: S: Short Social Problem Solving Inventory-Revised; α: Cronbach's α

Statistical analyses

Analyses were conducted using SPSS 21. We used descriptive statistics to describe participant characteristics and the prevalence of health behaviors. For describing the adherence to separate recommendations, we constructed two categories (*yes, no*) for all five health behaviors.

Missing values were handled according to the questionnaire manuals. For the EORTC QLQ-C30, HADS, and MAC the permitted number of missing values was one. For the SHORT SPSI-R, two missing values were permitted. The missing values were supplemented by using mean substitution, as recommended. Cases with missing values on days and time (PA), days, and number of servings (diet and alcohol) were removed from analysis. For other measures, less than 5% of the values were missing per value in a random pattern. We applied mean substitution for continuous covariates and for categorical covariates; we substituted the values of the modus.

To assess the contribution of the distal and proximal factors in explaining alcohol, vegetable, and fruit consumption, and PA we conducted four sequential multiple linear regression analyses (Tabachnick & Fidell, 2001). The variables were entered in four entry steps based on the social cognitive models (e.g., Reasoned Action Approach, I-Change-Model), the theoretical framework of the present study (de Vries et al., 2003; Fishbein & Ajzen, 2010). The models prescribe an ordering of steps. This implies that socio-demographic and cancer-related factors were entered in order to control for their possible influence. Then, the psychological factors were entered in step 2 to evaluate what they add to the explanation of variance over and above the first set, the background variables. Subsequently, in step 3, the influence of attitude, social support, and self-efficacy was assessed above the two prior sets. Intention was added it in the last step, according to the assumptions of the social cognitive theories, that intention is influenced by the prior added proximal factors.

To explore the correlates of smoking behavior (smoking vs quitting) among former smokers and current smokers, we conducted sequential logistic regression analysis (Tabachnick & Fidell, 2001). Never-smokers were excluded from this analysis. In the logistic regression analysis, we applied the same entry steps as described above. Results from sequential logistic regression analysis ($N = 139$) revealed large confidence intervals, due to the relative small number of participants and a large number of independent variables. Consequently, we conducted a second sequential logistic regression analysis, including fewer variables. The insignificant socio-demographic variables were removed, but core variables were entered in step 1 (age, gender, education level, type of cancer, and type of treatment). Significant psychological variables were added in entry step 2, such as the significant concepts from the EORTC QLQ-C30 (global health / QoL, cognitive functioning, social functioning, nausea / vomiting, insomnia, financial difficulties), and the subscales anxiety and depression from the HADS). In entry step 3 attitude, social support, and self-efficacy were added, and intention was added in the last step.

Furthermore, we were interested in the correlates to explain the overall degree of adherence to lifestyle recommendations. Therefore, we conducted sequential multiple regression analysis and applied the same protocol as described for the multiple regression analyses. Moreover, correlations between the continuously measured lifestyle behaviors (alcohol, vegetable, fruit consumption, PA) were assessed, using Spearman's correlation due to non-normally distributed data. Additionally, by conducting Chi-square tests among the five adherence scores we assessed the correlations between adherence to different health behaviors.

RESULTS

Recruitment and characteristics of the sample

In total, 455 cancer survivors were invited to participate in the study, 172 (37.8%) cancer survivors declined participation, 22 (4.8%) cancer survivors did not meet the inclusion criteria, and six (1.3%) respondents did not return the informed consent form. We included 255 (56%) respondents in the analysis. Participants' descriptive characteristics are displayed in Table 2.3. The prevalence of lifestyle behaviors is displayed in Table 2.4, and the adherence to recommendations is shown in Figure 2.1.

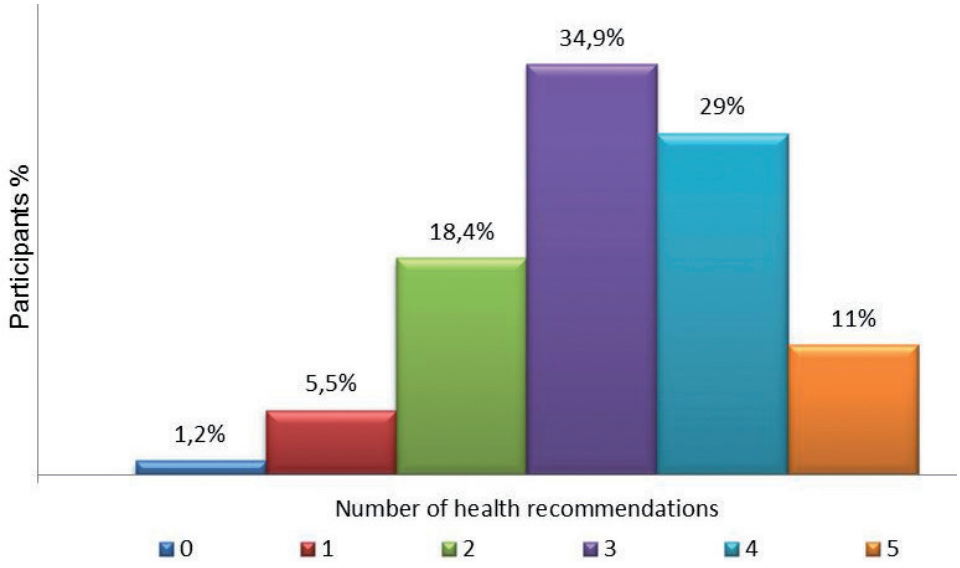

Figure 2.1 Adherence to lifestyle recommendations ($N = 255$).

Note: The five recommendations relate to physical activity, not smoking, alcohol, fruit and vegetable consumption.

Table 2.3 Characteristics of the sample (*N* = 255)

Variable		Variable	
Age years (*SD*)	60.6 (10.7)	Type of cancer	
Gender		Breast, *n* (%)	150 (58.8)
Female, *n* (%)	193 (70.7)	Colon, *n* (%)	51 (20.0)
Marital status		Other, *n* (%)[1]	54 (21.1)
Living with partner, *n* (%)	217 (86.5)	Type of treatment	
Educational level		Surgery alone, *n* (%)	32 (12.6)
Low, *n* (%)	137 (54.6)	Surgery and chemotherapy, *n* (%)	55 (21.7)
Medium, *n* (%)	47 (18.7)	Surgery and radiation therapy, *n* (%)	46 (18.1)
High, *n* (%)	67 (26.3)	Surgery, chemo- & radiation therapy, *n* (%)	92 (36.2)
Employment status		Other, *n* (%)	29 (11.4)
Not working, *n* (%)	158 (64.0)	Participation in aftercare	
Income level		Yes, *n* (%)	134 (53.0)
Below average, *n* (%)	51 (21.1)	Number of weeks after treatment, mean (*SD*)	26.5 (12.7)
Average, *n* (%)	70 (28.9)	HADS, mean, (*SD*)	8.2 (6.7)
Above average, *n* (%)	121 (50.0)	HADS anxiety, mean (*SD*)	4.7 (3.9)
BMI, mean (*SD*)	26.7 (9.4)	HADS depression, mean (*SD*)	3.5 (3.5)
< 18,5: underweight, *n* (%)	1 (0.4)	MAC	
18,5-25: healthy weight, *n* (%)	113 (45.7)	Positive adjustment, mean (*SD*)	51.1 (7.0)
25-30: overweight, *n* (%)	95 (38.5)	Negative adjustment, mean (*SD*)	29.6 (7.0)
30-35: obesity, *n* (%)	25 (10.1)	IPQR, mean (*SD*)	32.5 (10.9)
> 35: extreme obesity, *n* (%)	13 (5.3)	SPSIR	
EORTC QLQ-C30		Positive problem orientation, mean (*SD*)	2.4 (0.8)
Global health status, mean (*SD*)	78.1 (16.5)	Negative problem orientation, mean (*SD*)	1.1 (0.9)
Physical functioning, mean (*SD*)	85 (15.3)	Alcohol Attitude, mean (*SD*)	2.2 (1.3)
Role functioning, mean (*SD*)	79.4 (23.8)	Social support, mean (*SD*)	2.2 (1.5)
Emotional functioning, mean (*SD*)	80.1 (20.4)	Self-efficacy, mean (*SD*)	3.6 (1.3)

Table 2.3 *(Continued)*

Variable		Variable	
Cognitive functioning, mean (*SD*)	80.6 (22.0)	Intention, mean (*SD*)	2.4 (1.5)
Social functioning, mean (*SD*)	82.8 (21.4)	Physical ActivityAttitude, mean (*SD*)	4.6 (0.5)
Body Image, mean (*SD*)	82.3 (22.8)	Social support, mean (*SD*)	3.6 (1.2)
Fatigue, mean (*SD*)	27 (23.9)	Self-efficacy, mean (*SD*)	3.5 (1.1)
Nausea and Vomiting, mean (*SD*)	3.3 (10.3)	Intention, mean (*SD*)	4.7 (0.7)
Pain, mean (*SD*)	15.9 (22.6)	Nutrition Attitude, mean (*SD*)	4.1 (0.7)
Dyspnea, mean (*SD*)	12 (21.9)	Social support, mean (*SD*)	3.1 (1.3)
Insomnia, mean (*SD*)	26.1 (28.0)	Self-efficacy, mean (*SD*)	3.0 (0.9)
Appetite loss, mean (*SD*)	6.2 (16.6)	Intention vegetable cons., mean (*SD*)	4.2 (1.0)
Constipation, mean (*SD*)	8.2 (18.4)	Intention fruit cons., mean (*SD*)	4.0 (1.1)
Diarrhea, mean (*SD*)	7.5 (20.0)	Smoking[2] Attitude, mean (*SD*)	4.6 (0.8)
Financial difficulties, mean (*SD*)	10.6 (22.5)	Social support, mean (*SD*)	3.3 (1.6)
		Self-efficacy, mean (*SD*)	4.0 (1.7)
		Intention, mean (*SD*)	4.2 (1.4)

Note: n: numbers of participants; *SD*: standard deviation; BMI: Body Mass Index; EORTC: European Organisation for Research and Treatment of Cancer; QoL: Quality of Life; HADS: Hospital Anxiety and Depression Scale; MAC: Mental Adjustment to Cancer scale; IPQ: Illness Perception Questionnaire; SPSIR-R:S Short Social Problem Solving Inventory-Revised.

[1] other types of cancer were prostate (9%); Non-Hodgkin lymphoma (5.9%), ovarian (3.1%); bladder (1.2%); cervix (0.4%); Hodgkin lymphoma (0.4%)

[2] current and former smokers ($n = 142$)

Table 2.4 Lifestyle behaviors of the sample

Behavior			Meet recommendations	
	Mean (*SD*)	Median (IQR)	Yes, *n* (%)	No, *n* (%)
Smoking (*n* = 250)				
Never			108 (43.2)	
Former			97 (38.8)	
Current				45 (18)
Alcohol consumption (*n* = 244)[1]			184 (75.4)	60 (24.6)
Never			58 (22.8)	
Social (*n* = 186)			126 (67.7)	
Excessive (*n* = 186)				60 (32.3)
Male drinkers (*n* = 60)[1.1]			39 (65)	21 (35)
Female drinkers (*n* = 126)[1.2]			87 (69)	39 (31)
Vegetable consumption[2] (*n* = 248)	167.7 (90.8)	150 (107.2 -203.6)	68 (27.4)[2.1]	180 (72.6)
Fruit consumption[3] (*n* = 252)	1.8 (1.1)	2 (1-2)	138 (54.8)[3.1]	114 (45.2)
Physical activity in MET-min/week[4]				
Walking (*n* = 234)	1,299.3 (1188.5)	924 (396 – 2079)		
Moderate (*n* = 232)	1,600.6 (1623.8)	1,200 (210 – 2400)		
Vigorous (*n* = 235)	962.9 (1734.5)	0 (0 -1440)		
Total MET-min/week (*n* = 247)[4.1]	3,657.6 (3293.4)	2,613 (1284 – 5145)	216 (87.4)[4.2]	31 (12.6)

Note: *n*: numbers of participants; *SD*: standard deviation; IQR: interquartile range; MET: Metabolic Equivalent of Task
[1] number of alcohol consumptions per week; [1.1] male: ≤ 14 drinks per week; [1.2] female: ≤ 7 drinks per week
[2] vegetable consumption per day in grams; [2.1] ≥ 200 g vegetables per week
[3] number of fruit servings (à 100 g) a day. Up to 100 g fruit may be replaced by 150 g of fruit juice. [3.1] at least two servings of fruit per week
[4] MET-min/week = metabolic equivalent*minutes per week; [4.1] Total MET-min/week = walking + moderate + vigorous; [4.2] > 600 MET min per week

Correlations between the different lifestyle behaviors

We explored mutual correlations between the continuously measured lifestyle behaviors (alcohol, fruit, vegetable consumption, PA). Fruit consumption was significantly positively correlated to vegetable consumption, $r_s = .24$, $p < .001$, and we found a negative relationship between fruit consumption and alcohol consumption $r_s = -.14$, $p < .05$, which indicated that as fruit consumption was higher, alcohol consumption was lower. No other significant correlations were found.

Furthermore, we explored correlations between adherence (*yes, no*) to the five different health recommendations and found a statistically significant association between adherence to the smoking and fruit consumption recommendations (χ^2 (1) = 6.285, $p < .05$), however, the effect size represented a low association (*Cramer's V* = .16, $p < .05$). Crosstabs showed, that in smokers, 37.8% met the fruit recommendations, while in non-smokers (former smoker or never-smoker), 58.3% adhered to the fruit recommendations. No further associations were found between other adherence scores.

Correlates of lifestyle behaviors and adherence to recommendations

The results of the regression analyses to explain lifestyle behaviors and adherence to recommendations are presented in Table 2.5 and Table 2.6.

Alcohol consumption

Being male (p = .033) and lower self-efficacy toward adherence to the alcohol recommendation (p = .019) were correlated to a higher alcohol consumption. Less problems of insomnia (p = .058) contributed to a lesser extent to a higher alcohol consumption. Before intention was added to the model, higher levels of attitude and lower self-efficacy contributed significantly.

Vegetable consumption

Significant correlates of a higher vegetable consumption were: 1) a stronger intention toward adhering to the vegetable recommendation (p = .000), 2) higher scores on positive mental adjustment (p = .022), 3) a longer period since completion of primary treatment (p = .032), and, to a smaller extent, lower age (p = .067). A higher attitude and self-efficacy were significantly correlated with vegetable consumption before intention was added to the model.

Fruit consumption

A stronger intention toward adherence to the fruit recommendation was the only significant correlate in explaining a higher fruit consumption (p = .000). Before intention was added to the model, lower levels of depressive symptoms, and higher self-efficacy contributed significantly.

Physical activity

Significant correlates in explaining a higher amount of PA were 1) younger ages (p = .028), 2) higher scores on self-efficacy towards adherence to the PA recommendation (p = .005), 2) more pain (p = .039), more fatigue (p = .041). Before intention was added to the model, higher levels of attitude and self-efficacy also contributed significantly.

Not smoking

1) A more positive attitude toward not smoking (p = .003), 2) higher self-efficacy toward not smoking (p = .002), 3) lower levels of anxiety (p = .015), and 4) better social functioning (p = .038) were significantly correlated to not smoking among (former) smokers. Lower scores on global health/QoL (p = .052), lower scores on cognitive functioning (p = .055), and not having colon cancer (p = .053) contributed to a smaller extent.

Table 2.5 Correlates of lifestyle behaviors

	Lifestyle behavior														
	Alcohol consumption (*N* = 223)			Vegetable consumption (*N* = 225)			Fruit consumption (*N* = 228)			Physical Activity (*N* = 225)			Nonsmoking (*N* = 141)[1]		
Variable	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	ExpB	(95% CI)	*p*[4]
Age	.037	(-.15; .23)	.698	-1.307	(-2.70; .09)	.067	.007	(-.01; .02)	.367	-13.723	(-25.94; -1.51)	**.028**	.936	(.86; 1.02)	.127
Female gender	-5.805	(-11.13; -4.77)	**.033**	7.579	(-32.98; 48.14)	.713	.211	(-.20; .63)	.315	-11.993	(-361.07; 337.08)	.946	.394	(.04; 4.45)	.399
Marital status															
Without partner	ref			ref			ref			ref					
With partner	-4.986	(-10.75; .73)	.089	24.032	(-17.65; 65.72)	.257	.174	(-.25; .60)	.421	-122.543	(-478.92; 233.83)	.498			
Education															
Low	ref			ref			ref			ref			ref		.198
Medium	-1.165	(-5.60; 3.72)	.605	14.521	(-17.78; 64.82)	.376	-.019	(-.35; .31)	.907	-176.621	(-451.64; 98.40)	.207	2.664	(.52; 13.75)	.242
High	-2.370	(-6.64; 1.90)	.274	18.004	(-1.71; 49.72)	.264	.075	(-.25; .40)	.644	-215.435	(-474.80; 43.93)	.103	5.451	(.72; 41.44)	.101
Income															
Above average	ref			ref			ref			ref					
Average	-2.646	(-6.42; 1.13)	.168	-19.041	(-47.66; 9.58)	.191	-.118	(-.41; .17)	.423	71.279	(-169.63; 312.19)	.560			
Below average	-4.183	(-9.78; 1.41)	.142	-6.040	(-47.44; 35.36)	.774	.022	(-.40; .45)	.917	-77.931	(-431.78; 275.19)	.654			
Cancer type															
Other	ref			ref			ref			ref			ref		.096
Breast	-1.244	(-7.97; 5.48)	.716	-1.055	(-51.79; 49.68)	.967	-.046	(-.56; .47)	.862	137.614	(-291.14; 566.37)	.527	.489	(.02; 12.11)	.662
Colon	-1.859	(-8.18; 4.46)	.562	5.333	(-42.80; 53.47)	.827	.002	(-.49; .49)	.995	15.656	(-390.56; 421.88)	.939	.045	(.00; 1.04)	.053
Treatment															
All[2]	ref			ref			ref			ref			ref		.554
Surgery alone	1.914	(-4.18; 8.01)	.536	-6.261	(-51.72; 39.20)	.786	-.077	(-.54; .39)	.745	-67.186	(-443.93; 309.56)	.725	.483	(.04; 5.73)	.565
Surgery, chemo	.991	(-3.40; 5.38)	.657	-.259	(-33.72; 33.20)	.988	-0.52	(-.39; .29)	.764	56.566	(-223.74; 3236.87)	.691	3.975	(.38; 41.21)	.247
Surgery, radiation	.228	(-4.88; 5.34)	.930	-15.436	(-52.36; 21.49)	.411	.031	(-.35; .21)	.872	-43.457	(-358.83; 271.92)	.786	.471	(.06; 3.68)	.473
Other	-.041	(-7.96; 7.88)	.992	-.947	(-60.33; 58.44)	.975	-.144	(-.74; .45)	.633	-70.914	(-559.88; 418.05)	.775	1.275	(.04; 43.16)	.893

Table 2.5 Correlates of lifestyle behaviors *(Continued)*

	Lifestyle behavior														
	Alcohol consumption (*N* = 223)			Vegetable consumption (*N* = 225)			Fruit consumption (*N* = 228)			Physical Activity (*N* = 225)			Nonsmoking (*N* = 141)[1]		
Variable	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	ExpB	(95% CI)	*p*[4]
Aftercare															
No	ref			ref			ref			ref					
Yes	1.914	(-5.00; 2.39)	.487	-15.766	(-43.27; 11.74)	.260	-.070	(-.35; .21)	.622	-60.426	(-291.29; 170.44)	.606			
Time after treatment	.991	(-.236; .026)	.117	1.053	(.09; 2.02)	**.032**	.003	(-.01; .01)	.500	.787	(-7.26; 8.83)	.874			
BMI	-.257	(-.654; .14)	.203	1.654	(-1.32; 4.63)	.274	-.013	(-.04; .02)	.376	-7.844	(-33.21; 17.53)	.453			
Glob. Health/ QoL	.044	(-.10; .12)	.543	-.412	(-1.48; .67)	.451	-.002	(-.01; .01)	.732	.246	(-8.74; 9.23)	.957	.926	(.86; 1.00)	.052
Physical funct.	.008	(-.17; .18)	.929	-.676	(-1.99; .46)	.313	-.007	(-.02; .01)	.314	5.129	(-6.24; 16.50)	.374			
Role funct.	-.076	(-.20; .05)	.199	.521	(-.38; 1.42)	.254	.006	(-.00; .02)	.164	4.379	(-3.05; 11.81)	.246			
Emotional funct.	-.078	(-.20: .05)	.226	.263	(-.71; 1.24)	.593	.003	(-.01; .01)	.554	7.327	(-.94; 15.59)	.082			
Cognitive funct.	-.013	(-.12; .09)	.796	-.079	(-.86; .70)	.840	-.002	(-.01; .01)	.600	.192	(-7.84; 6.51)	.953	.957	(.92; 1.00)	.055
Social funct.	.070	(-.05; .19)	.234	-.466	(-1.32; .39)	.285	-.003	(-.01; .01)	.488	-.661	(-7.84; 6.51)	.856	1.046	(1.00; 1.09)	**.038**
Body Image	.016	(-.07; .10)	.703	.010	(-.65; .66)	.977	.000	(-.01; .01)	.935	1.977	(-3.43; 7.38)	.471			
Fatigue	.046	(-.07; .16)	.436	.269	(-.63; 1.16)	.554	.001	(-.01; .01)	.744	7.732	(.30; 12.15)	**.041**			
Nausea, vomiting	-.043	(-.23; .15)	.651	-.071	(-1.56; 1.42)	.925	.000	(-.02; .01)	.957	-2.743	(-14.78; 9.29)	.654	.945	(.89; 1.01)	.081
Pain	-.034	(-.13; .06)	.472	.169	(-.56; .90)	.650	.001	(-.01; .01)	.784	6.229	(.31; 15.16)	**.039**			
Dyspnea	-.025	(-.11; .06)	.553	-.428	(-1.07;.21)	.188	-.004	(-.01; .00)	.277	.010	(-5.19; 5.21)	.997			
Insomnia	-.062	(-.13; .00)	.058	.214	(-.27; .70)	.382	.000	(-.00; .01)	.866	.850	(-3.13; 4.83)	.674	.977	(.95; 1.01)	.108
Appetite loss	.033	(-.08; .15)	.576	-.168	(-1.05; .72)	.708	.001	(-.01; .01)	.805	4.505	(-2.91; 11.91)	.223			
Constipation	-.036	(-.12; .03)	.452	-.374	(-1.10; .35)	.310	-.005	(-.01; .00)	.186	-5.298	(-11.12; .53)	.074			
Diarrhea	.030	(-.13; .06)	.503	.111	(-.59; .81)	.754	.003	(-.01; .01)	.383	.151	(-5.57; 5.87)	.959			
Financial probl.	.001	(-.09; .09)	.987	-.339	(-.99; .31)	.302	-.001	(-.01; .01)	.827	.024	(-5.44; 5.49)	.993	.977	(.95; 1.01)	.157
Anxiety	-.080	(-.78; .62)	.820	-.084	(-5.43; 5.26)	.975	-.008	(-.06; .05)	.760	41.203	(-3.24; 85.65)	.069	.682	(.50; .93)	**.015**
Depression	.170	(-.60; .94)	.662	-.204	(-6.03; 5.62)	.945	-.027	(-.09; .03)	.365	-33.248	(-80.72; 14.22)	.169	1.187	(.89; 1,58)	.236

Table 2.5 Correlates of lifestyle behaviors *(Continued)*

	Lifestyle behavior														
	Alcohol consumption (*N* = 223)			Vegetable consumption (*N* = 225)			Fruit consumption (*N* = 228)			Physical Activity (*N* = 225)			Nonsmoking (*N* = 141)[1]		
Variable	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	ExpB	(95% CI)	*p*[4]
Pos. adjustment	-.057	(-.32; .20)	.667	2.297	(.34; 4.26)	**.022**	.013	(-.02; .03)	.198	12.872	(-3.001; 28.75)	.111			
Neg. adjustment	-.149	(-.48; .18)	.373	-1.992	(-4.40; .42)	.105	.005	(-.02; .03)	.714	6.782	(-13.48; 27.04)	.510			
Illness perception	-.034	(-.24; .17)	.738	.782	(-.71; 2.28)	.303	.010	(-.01; .03)	.189	-4.296	(-16.86; 8.27)	.501			
PPO	1.324	(-1.05; 3.70)	.273	-4.790	(-22.60; 13.02)	.596	-.001	(-.18; .18)	.991	-78.106	(-225.46; 69.24)	.297			
NPO	.457	(-1.75; 2.66)	.684	2.240	(-14.26; 18.74)	.789	-.078	(-.25; .09)	.360	-82.287	(-222.29; 57.73)	.248			
Attitude	1.522	(-.32; 3.36)	.105	17.076	(-1.98; 36.13)	.079	-.016	(-.21; .18)	.872	192.876	(-19.74; 405.49)	.075	5.707	(1.83; 17.7)	**.003**
Social support	-.004	(-.01; .00)	.290	-.012	(-.19; .17)	.894	0.00	(-.00; .00)	.710	-.111	(-1.62; 1.40)	.884			
Self-efficacy	-1.532	(-2.81; -.25)	**.019**	11.342	(-3.70; 26.36)	.138	.070	(-.09; .23)	.378	181.637	(54.71; 308.56)	**.005**	2.583	(1.42; 4.69)	**.002**
Intention	.479	(-1.02; 1.98)	.530	36.980	(23.16; 50.81)	**.000**	.597	(.48; .72)	**.000**	137.551	(-23.15; 298.25)	.093	.583	(.58; 1.56)	.852
Constant B (SE)	35.146 (20.40)			-105.53 (151.51)			-1.63 (1.54)			-2456.07 (1356.25)			2.96 (5.07)		
R^2	.297			.415			.514			.312					
Sig. F Change	.530			.000			.000			.093					
Cox & Snell R^2															.518
Nagelkerke R^2															.725
Model X^2															102.87
p															.000

Note: From Sequential Multiple Regression (continuous outcomes) and Sequential Logistic Regression (smoking) entry step 4 is displayed. Forced entry (enter) method was used; Abbreviations: ExpB: odds ratio; ref: reference group; BMI: Body Mass Index; EORTC: European Organisation for Research and Treatment of Cancer; QoL: Quality of Life; HADS: Hospital Anxiety and Depression Scale; neg./pos. adjustment from MAC: Mental Adjustment to Cancer Scale; IPQ: Illness Perception Questionnaire; SPSIR-R:S Short Social Problem Solving Inventory-Revised; Chemo: chemotherapy; PPO: positive problem orientation; NPO: negative problem orientation;

[1]Dependent variable encoding: if participant is former smoker 1; if participant is current smoker 0; never-smokers were excluded;

[2]all = surgery + chemotherapy + radiation

[4]p-value of Wald test is presented

Table 2.6 Correlates of adherence to recommendations (*N* = 236)

	Adherence to an increasing number of lifestyle recommendations											
	Model 1			Model 2			Model 3			Model 4		
Variable	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*
Age	.000	(-.02; .02)	.962	.004	(-.13; .02)	.610	-.006	(-.02; .01)	.441	-.010	(-.02; .01)	.201
Female gender	.655	(.18; 1.13)	.007	.686	(.18; 1.19)	.008	.398	(-.60; .86)	.088	.462	(.02; .90)	**.039**
Marital status: with partner	.566	(.08;1.06)	.024	.460	(-.55; .98)	.080	.284	(-.17; .74)	.221	.391	(-.44; .83)	.078
Education, low=ref												
Medium	.200	(-.19; .59)	.307	.215	(-.19; .62)	.291	.035	(-.33; .40)	.850	-.019	(-.37; .33)	.915
High	.601	(.24; .96)	.001	.534	(.15; .92)	.006	.029	(-.34; .40)	.877	.117	(-.33; .47)	.517
Income, above average=ref.												
Average	.067	(-.28; .42)	.703	-.021	(-.38; .33)	.907	-.063	(-.38; .25)	.695	-.030	(-.33; .27)	.844
Below average	.062	(-.40; .52)	.789	.037	(-.48; .56)	.889	-.203	(-.66; .26)	.384	-.083	(-.52; .36)	.709
Cancer type, other=ref												
Breast	.459	(-.12; 1.04)	.122	.281	(-.35; .91)	.381	.130	(-.43; .69)	.646	.046	(-.47; .60)	.813
Colon	.291	(-.26; .84)	.296	.224	(-.37; 82)	.461	.087	(-.41;.62)	.744	.145	(-.36; .65)	.570
Treatment; all[1]=ref												
Surgery alone	.076	(-.47; .60)	.805	-.004	(-.57; .56)	.988	.128	(-.39; .64)	.626	.033	(-.46; .52)	.894
Surgery + chemo	.049	(-.31; .50)	.644	.053	(-.37; .47)	.803	.025	(-.35; .40)	.897	.027	(-.33; .39)	.882
Surgery + radiation	-.467	(-.90; -.04)	.034	-.459	(-.91; -.01)	.046	-.209	(-.69; .11)	.157	-.264	(-.66; .14)	.195
Other	.577	(-.11; 1.26)	.100	.573	(-.48; 1.44)	.123	.123	(-.53; 78)	.711	.107	(-.52; .73)	.736
Participating in aftercare	-.083	(-.41; .24)	.611	.006	(-.33; .35)	.971	-.123	(-.42; .18)	.420	-.105	(-.39; .18)	.472
Time after treatment	.009	(-.00; .02)	.098	.010	(-.01; .02)	.109	.009	(-.00; .02)	.091	.012	(.00; .02)	**.024**
BMI	.021	(-.01; .06)	.230	.017	(-.02; .05)	.347	.013	(-.02; .05)	.445	.006	(-.03; .04)	.734
Glob. Health / QoL	-	-	-	-.012	(-.03; .01)	.080	-.010	(-.02; .00)	.086	-.009	(-.02; .00)	.115
Physical funct.	-	-	-	-.003	(-.02; .02)	.740	-.004	(-.02; .01)	.604	-.004	(-.02; .01)	.619
Role funct.	-	-	-	.014	(.03; .03)	.015	.010	(.01;.02)	.036	.010	(.00; .02)	**.027**
Emotional funct.	-	-	-	.001	(-.01; .01)	.854	.006	(-.01; .02)	.320	.007	(-.00; .02)	.184
Cognitive funct.	-	-	-	-.012	(-.02; -.00)	.008	-.009	(-.02; -.00)	.030	-.009	(-.02; -.00)	**.026**

Table 2.6 Correlates of adherence to recommendations (*N* = 236) *(Continued)*

		Adherence to an increasing number of lifestyle recommendations											
		Model 1			Model 2			Model 3			Model 4		
Variable		B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*	B	(95% CI)	*p*
Social funct.		-	-	-	-.004	(-.01; .01)	.493	-.004	(-.01; .01)	.364	-.004	(-.01; .01)	.400
Body Image		-	-	-	.002	(-.01; .01)	.658	.002	(-.01; .01)	.657	.002	(-.01; .01)	.554
Fatigue		-	-	-	.001	(-.01; .01)	.922	.000	(-.01; .01)	.980	.001	(-.01; .01)	.779
Nausea en Vomiting		-	-	-	-.010	(-.03; .01)	.254	-.010	(-.03; .01)	.198	-.005	(-.02; .01)	.517
Pain		-	-	-	.002	(-.01; .01)	.713	.005	(-.00; .01)	.243	.006	(-.00; .01)	.140
Dyspnea		-	-	-	-.006	(-.01; .00)	.124	.002	(-.01; .01)	.620	.001	(-.01; .01)	.799
Insomnia		-	-	-	-.002	(-.01; .00)	.576	.001	(-.01; .01)	.998	.001	(-.01; .01)	.992
Appetite loss		-	-	-	-.002	(-.01; .01)	.759	-.001	(-.01; .01)	.856	-.001	(-.01; .01)	.869
Constipation		-	-	-	-.006	(-.01; .00)	.202	-.002	(-.01; .01)	.653	-.002	(-.01; .00)	.544
Diarrhea		-	-	-	-.001	(-.01; .01)	.811	.001	(-.01; .01)	.862	-.001	(-.01; .01)	.824
Financial difficulties		-	-	-	-.005	(-.01; .00)	.268	-.003	(-.01; .01)	.983	-.002	(-.01; .01)	.531
Anxiety		-	-	-	-.033	(-.10; .03)	.325	-.007	(-.07; .05)	.818	-.018	(-.07; .04)	.531
Depression		-	-	-	-.016	(-.09; .05)	.652	-.049	(-.11; .01)	.127	-.024	(-.09; .04)	.445
Positive adjustment		-	-	-	.023	(.00; .05)	.048	.025	(.01; .05)	.016	.020	(.00; .04)	**.045**
Negative adjustment		-	-	-	.007	(-.02; .05)	.648	.026	(-01; .05)	.058	.023	(-.00; .05)	.095
Illness perception		-	-	-	.005	(-.01; .02)	.573	.003	(-.01; .02)	.693	.002	(-.01; .02)	.825
PPO		-	-	-	.042	(-.16; .24)	.684	-.003	(-.19; .018)	.975	.006	(-.17; .18)	.944
NPO		-	-	-	.088	(-.12; .29)	.394	.115	(-.07; .30)	.216	.089	(-.09; .26)	.317
Alcohol:	Attitude	-	-	-	-	-	-	.084	(-.03; .20)	.158	.020	(-.13; .17)	.783
	Social support	-	-	-	-	-	-	.000	(.00; .00)	.184	.000	(.00; .001)	.266
	Self-efficacy	-	-	-	-	-	-	.052	(-.06; .16)	.344	.053	(-.05; .16)	.306
Nutrition:	Attitude	-	-	-	-	-	-	.373	(.17; .58)	.000	.265	(.06; .47)	**.010**
	Social support	-	-	-	-	-	-	-.001	(-.00; .00)	.301	-.001	(-.00; .00)	.295
	Self-efficacy	-	-	-	-	-	-	.112	(-.06; .28)	.200	-.037	(-.21; .14)	.671

Table 2.6 Correlates of adherence to recommendations (*N* = 236) *(Continued)*

		Adherence to an increasing number of lifestyle recommendations											
		Model 1			Model 2			Model 3			Model 4		
Variable		**B**	**(95% CI)**	***p***	**B**	**(95% CI)**	***p***	**B**	**(95% CI)**	***p***	**B**	**(95% CI)**	***p***
Physical Activity:	Attitude	-	-	-	-	-	-	-.184	(-.46; .09)	.193	-.157	(-.44; .12)	.269
	Social support	-	-	-	-	-	-	-.001	(-.00; .00)	.170	-.001	(-.00; .00)	.206
	Self-efficacy	-	-	-	-	-	-	.104	(-.07; .27)	.227	.080	(-.09; .25)	.347
Smoking:	Attitude							.153	(-.07; .38)	.184	.100	(-.13; .34)	.387
	Social support	-	-	-	-	-	-	.020	(-.06; .10)	.623	.000	(-.08; .08)	.993
	Self-efficacy	-	-	-	-	-	-	.323	(.17; .47)	.000	.330	(.19; 48)	**.000**
Intention													
Alcohol cons.		-	-	-	-	-	-	-	-	-	.066	(-.05; .18)	.373
Vegetable cons.		-	-	-	-	-	-	-	-	-	.112	(-.04; .26)	.144
Fruit cons.		-	-	-	-	-	-	-	-	-	.263	(.13; .39)	**.000**
Physical activity		-	-	-	-	-	-	-	-	-	.045	(-.16; .25)	.668
Smoking		-	-	-	-	-	-	-	-	-	-.009	(-.12; .10)	.874
Constant B (SE)			.932 (.77)			.795 (1.85)			-2.728 (1.78)			-3.72 (1.72)	
R^2			.172			.289			.502			.567	
Sig. F Change			.000			.109			.000			.000	

Note: From Sequential Multiple Regression (continuous outcomes) and Sequential Logistic Regression (smoking) entry step 4 is displayed. Forced entry (enter) method was used. Abbreviations: ExpB: odds ratio; ref: reference group; BMI: Body Mass Index; EORTC: European Organisation for Research and Treatment of Cancer; QoL: Quality of Life; HADS: Hospital Anxiety and Depression Scale; MAC: Mental Adjustment to Cancer Scale; IPQ: Illness Perception Questionnaire; SPSIR-R:S Short Social Problem Solving Inventory-Revised; Chemo: chemotherapy; PPO: positive problem orientation; NPO: negative problem orientation; R^2:correlation coefficient squared

[1]all = surgery + chemotherapy + radiation;

[2]Dependent variable encoding: if participant is former smoker 1; if participant is current smoker 0 p-value of Wald test is presented

Adherence to lifestyle recommendations

Significant correlates in explaining adherence to an increasing number of lifestyle recommendations were 1) a more positive intention toward following fruit (p = .000) recommendation, 2) higher scores on self-efficacy toward not smoking (p = .000), a more positive attitude toward following the diet recommendations (p = .010), and 3) three psychological factors (role functioning, p = .027; cognitive functioning, p= .026; positive mental adjustment to cancer, p = .045). In addition, a longer period after completing primary cancer treatment (p = .024) and female gender (p = .039) contributed to the adherence to lifestyle recommendations.

DISCUSSION

This cross-sectional study assessed the prevalence and correlates of five lifestyle behaviors in early cancer survivors. Additionally, contributing factors to explain the extent of adherence to lifestyle recommendations were assessed, from which only little evidence is available up to date. The special feature of this study is that for the first time both, distal and proximal factors, derived from social cognitive theories, were assessed. In all analyses, the required number of participants, in terms of power, has been achieved. Valuable information was gained about important factors that may explain engagement in lifestyle behaviors and the extent of adherence to recommendations. The highest prevalence in followed recommendations have been detected in PA (87.4%), refrain from smoking (82%), and alcohol consumption (75.4%). Low prevalence was found in adherence to the fruit recommendation (54.8%) and, in particular in adherence to the vegetable recommendation (27.4%).

Physical activity

The proportion of participants meeting the PA recommendations (87.4%) were much higher than results earlier reported (Blanchard et al., 2008; LeMasters et al., 2014; Stevinson et al., 2014). In these studies, however, a different measurement instrument was used, which might explain the discrepancy. Our results are rather consistent with results from studies, which also used the IPAQ Short form; however, over-reporting might have been occurred (Bertheussen, Oldervoll, Kaasa, Sandmael, & Helbostad, 2013; Craig et al., 2003; Cuevas et al., 2014). An additional explanation for the fairly high level of PA might be the relatively good health of the participants. The sample characteristics (Table 2.1) showed rather high scores on the functioning scales as well as low scores on the symptom scales of the EORTC QLQ-C30, and low scores on the HADS. In addition, more than half of the sample used some form of cancer aftercare, which often had a strong emphasis on PA. From the individuals who were engaged in aftercare, almost 50% were supported by an oncology physiotherapist or participated in a rehabilitation program including physical exercises. This might also partly explain the high level of PA among our sample of survivors.

Higher scores on self-efficacy lower ages, more pain, and more fatigue were the only significant correlates of a higher level of PA. Causal directions cannot be determined, but a possible explanation for the positive relationships between pain respectively fatigue and a higher level of PA could be, that pain and fatigue might have been reasons to get supervised by an (oncological) physiotherapist, or to follow a rehabilitation program. In the Netherlands, guidelines to cope with pain and fatigue are characterized by an active approach (gradually building up PA).
As described before, PA is an important modifiable lifestyle behavior, which can have an impact on health outcomes in cancer survivors. Even though most of the cancer survivors meet the recommendations in our study, in clinical practice, attention should be given to the maintenance and if possible, to a gradual increase of PA.

Smoking

Of our sample, 18% were current smoker, which is a higher rate of smokers compared to findings from other research (Del Valle et al., 2014; Weaver et al., 2013b; Westmaas et al., 2014). Most of the former smokers quitted before cancer diagnosis, and half of the current smokers intended to quit within six months. The strongest correlates of not smoking were a higher self-efficacy, a more positive attitude toward nonsmoking, lower anxiety and better social functioning, while in other research, where social cognitive and psychological variables were not considered, younger age, lower education/ income, greater alcohol consumption, and cancer type were correlated with current smoking (Westmaas et al., 2014). However, qualitative results of Berg et al. (2013), confirmed that a positive attitude towards quitting may help to (remain) quit, and that feelings of anxiety and low self-efficacy were reasons to continue smoking, which corresponds to our results. Additionally, addiction and habit were also mentioned as important reasons to continue smoking. However, our study did not confirm their result, that depressive symptoms were correlated with continued smoking, possibly due to the low prevalence of depressive symptoms in our sample. Besides above mentioned findings, concepts of addiction and habit and a possible interaction with other risk behaviors (e.g., alcohol consumption) should be taken into consideration in further research. Because of the increased health risk of continued smoking, the high rate of motivated current smokers, and limited research in this field, further exploration of predictors and the development of programs to (remain) quit smoking for cancer survivors are needed.

Alcohol consumption

Among alcohol drinkers, more than one third drank more than recommended, and 18.7% preformed binge drinking (six or more glasses a day, 1-3 times per month or even more

frequently), which is considerably more than reported in other studies (Bidstrup et al., 2013; Del Valle et al., 2014; Grimmett, Bridgewater, Steptoe, & Wardle, 2011). Possibly, people might not be aware of their excessive alcohol consumption and its long-term risk (Dumalaon-Canaria, Hutchinson, Prichard, & Wilson, 2014; Kwan et al., 2010; McLaughlin et al., 2014). Earlier studies in older adults reported that alcohol consumption was related to positive sensations among older adults (Chan, von Muhlen, Kritz-Silverstein, & Barrett-Connor, 2009; Lang, Wallace, Huppert, & Melzer, 2007). Our finding, that low self-efficacy was associated with higher alcohol consumption might possibly be explained by the difficulty of breaking a particular drinking habit, assuming that a substantial number of participants consumed more than recommended, and thus drank regularly, and as discussed above, alcohol consumption might be accompanied by positive short term consequences. Given the long-term health risks, an increase of awareness and knowledge about personal (excessive) alcohol consumption and its consequences should be pursued in cancer survivors. It should be considered that our sample included never-drinkers, social drinkers and excessive drinkers, who possibly could be regarded as distinct groups.

Vegetable and fruit consumption

Vegetable and fruit consumption were low in our sample, however, consistent or higher than in American cancer survivors (Blanchard et al., 2008; LeMasters et al., 2014; Milliron, Vitolins, & Tooze, 2014). Compared to European cancer survivors, especially vegetable consumption was considerably lower (Dijkstra, Neter, Brouwer, Huisman, & Visser, 2014; Grimmett et al., 2011; Ocké et al., 2013). These low prevalence rates clearly demonstrate that the vegetable and fruit consumption can be greatly improved.

In diet recommendations and studies, vegetable and fruit consumption often are treated and presented as one single behavior, although there are differences in the prevalence and consumption of fruit and vegetables, for example, in the Netherlands, vegetables are mostly a part of the main meals and fruit is often eaten as a snack between meals or as a desert. Our study showed only a small correlation between vegetable and fruit consumption and the factors associated with both behaviors were different, which advocates for treating vegetable and fruit consumption as two different types of behavior. A longer period after completing primary cancer treatment was correlated with a higher amount of vegetable consumption, but not with fruit consumption. The preparation of vegetables could take some effort, and possibly, cancer survivors might spend more effort in the preparation of meals including vegetables, the more time passed after the cancer treatment with possible side effects. Furthermore, the sense of taste could be affected during the cancer treatment and improve again afterwards. Possibly, this also could be a reason for a temporary change in diet. However, evidence is limited yet about correlates and predictors of vegetable and fruit consumption in cancer survivors.

In the present study, the strongest correlates in vegetable and fruit consumption were positive intentions, while being women and having a higher education were found to be correlated to meeting vegetable and fruit recommendation in other research (Mayer et al., 2007). Furthermore, we identified that more excessive alcohol drinkers and smokers were less likely to adhere to the fruit recommendation. The latter might be explained by assuming that smokers possibly smoke at times when nonsmokers eat fruit (e.g., during break times at work). These results confirm prior findings that risk behaviors among adults tend to cluster (Spring, King, Pagoto, Van Horn, & Fisher, 2015). Moreover, it is shown that combinations or clustering of risk behaviors might be involved with additional health risks (Bradbury, Appleby, & Key, 2014).

To disentangle separate determinants of vegetable and fruit consumption, more specific research is needed. In clinical practice, attention should be given to vegetable and fruit consumption to increase the intake in cancer survivors, preferably tailored to personal attitudes, self-efficiency expectations, and intentions.

Adherence to recommendations

In our study, the adherence to recommendations (Figure 2.1) was overall more positive in comparison with other studies (Blanchard et al., 2008; O'Neill et al., 2013; Schlesinger et al., 2014). Higher scores on attitude, self-efficacy, and intention of some of the lifestyle behaviors were the strongest correlates with adherence to an increasing number of recommendations (Table 2.6). The strong association between self-efficacy toward nonsmoking and adherence to recommendations could be explained by the presence of never-smokers (43.2%) in our sample.

Not much is known about contributing factors in explaining adherence to an increasing number of lifestyle recommendations in cancer survivors, yet. We found that positive mental adjustment contributed ($p = .045$), what could be in line with findings from other research, reporting that emotional benefit-finding related to cancer was positively associated with engagement in several health behaviors (Low et al., 2014). Although the two concepts are not the same, we could assume that cancer survivors who are able to cope more positively with their situation might be more likely to be involved in healthier lifestyle behaviors. However, a direction en causality of this association cannot be determined in this study. We emphasize again, that especially for cancer survivors it may be important to live as healthy as possible. Therefore, more insight is needed in the determinants of engagement in as much as possible healthy lifestyle behaviors, and, furthermore, cancer aftercare programs should aim to target multiple lifestyle behaviors.

Different patterns of correlates

For each separate lifestyle behavior we found different prevalence and different patterns of correlates. In accordance with the assumptions of social cognitive theories, we identified proximal variables and intention as strongest correlates in all examined behaviors, although with variations in contribution. Our results confirm theoretical assumptions, that the relative contribution of attitudes, self-efficacy and social influences can differ from one person to another and from one behavior to another (Fishbein & Ajzen, 2010). Regarding the distal factors, we found notably less, but also different patterns of correlations between the lifestyle behaviors. Overall, subscales of the EORTC QLQ-C30 provided the most influential distal factors, although the contribution of all distal factors (socio-demographic, cancer-related, psychological) was considerably lower than the contribution of the proximal factors and intention. It would be interesting to investigate a possible predicting role of the distal factors and possible mediation effects of the proximal factors in longitudinal research.

Limitations

This study was subject to some limitations. Due to the cross-sectional design, no causal relationships and directions of associations could be determined. Furthermore, the collected data were based on self-report questionnaires. In particular, self-reported outcomes of lifestyle behaviors should be interpreted carefully. In addition, the results of his study might not be generalizable to all cancer survivors, because more than half of the sample has been women with breast cancer. Even though, cancer type and gender had limited correlates in explaining the lifestyle behaviors.

In measuring PA using IPAQ short form, possibly over-reporting might have been occurred. This is known as a typical problem in several previous studies using the same questionnaire (Lee, Macfarlane, Lam, & Stewart, 2011). In this study, the cut-off point to achieve the PA recommendations was 600 MET-min/week, which is in accordance with the scorings guideline of the IPAQ questionnaire. However, in guidelines, different cut-off points or ranges were indicated (Garber et al., 2011; Haskell et al., 2007; Nelson et al., 2007). Our cut-off point choice might have affected the outcome of the adherence to PA recommendations.

With regard to alcohol consumption, it could be that the results on alcohol are more a reflection of social drinkers and excessive drinkers, because some questions were focused on alcohol consumption, and non-drinkers might have found them to be not applicable to themselves. Although, similar questions were also applied to non-drinkers in prior research (Schulz et al., 2014).

There was a probability that significant correlates could have occurred by chance due to multiple testing. However, by applying sequential multiple linear / logistic regression analyses, the chance on Type 1 error was rather small (Tabachnick & Fidell, 2001). Moreover,

given the adequate power, the *p*-values were highly significant which indicated that our estimates were relatively accurate.

CONCLUSIONS

Overall, the participants of our study were more engaged in healthy lifestyle behaviors compared to other research, however, especially vegetable and fruit consumption were poor and should be considerably improved. The various lifestyle behaviors and the adherence to recommendations were influenced by different patterns of correlates, from which self-efficacy, attitudes, and intention were the strongest, although their contribution varied among the different lifestyle behaviors. Our findings emphasized that all examined lifestyle behaviors need to be encouraged in cancer survivors, with taken into consideration that each lifestyle behavior is influenced by a specific set of mainly motivational correlates.

The *Kanker Nazorg Wijzer* (Cancer Aftercare Guide) protocol: a systematic development of a web-based computer tailored intervention providing psychosocial and lifestyle support for cancer survivors

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ABSTRACT

Background

After primary treatment, many cancer survivors experience psychosocial, physical, and lifestyle problems. To address these issues, we developed a web-based computer tailored intervention, the Kanker Nazorg Wijzer (Cancer Aftercare Guide), aimed at providing psychosocial and lifestyle support for cancer survivors. The purpose of this article is to describe the systematic development and the study design for evaluation of this theory and empirical based intervention.

Methods/Design

For the development of the intervention, the steps of the Intervention Mapping protocol were followed. A needs assessment was performed consisting of a literature study, focus group interviews, and a survey study to get more insight into cancer survivors' health issues. This resulted in seven problem areas that were addressed in the intervention: cancer-related fatigue, return to work, anxiety and depression, social relationships and intimacy, physical activity, diet, and smoking. To address these problem areas, the principles of problem-solving therapy and cognitive behavioral therapy are used. At the start of the intervention, participants have to fill in a screening questionnaire. Based on their answers, participants receive tailored advice about which problem areas deserve their attention. Participants were recruited from November 2013 through June 2014 by hospital staff from 21 hospitals in the Netherlands. Patients were selected either during follow-up visits to the hospital or from reviews of the patients' files. The effectiveness of the intervention is being tested in a randomized controlled trial consisting of an intervention group (n = 231) and waiting list control group (n = 231) with a baseline measurement and follow-up measurements at three, six, and 12 months.

Discussion

Using the Intervention Mapping protocol resulted in a theory and evidence-based intervention providing tailored advice to cancer survivors on how to cope with psychosocial and lifestyle issues after primary treatment.

BACKGROUND

With advances in cancer detection and treatment and an aging population, the number of cancer survivors is increasing significantly (The Dutch Cancer Society, 2011). It is well-known that survivors face a variety of difficulties and challenges after treatment, such as anxiety, depression, fear of recurrence, fatigue, pain, physical and cognitive limitations, difficulties with employment, and sexual dysfunctions (Duijts et al., 2014; Harrington, Hansen, Moskowitz, Todd, & Feuerstein, 2010; Kattlove & Winn, 2003; Mehnert & Koch, 2008; Prue, Rankin, Allen, Gracey, & Cramp, 2006; Simard et al., 2013; Valdivieso, Kujawa, Jones, & Baker, 2012; Wu & Harden, 2015). These issues can have a negative impact on quality of life (QoL; Harrington et al., 2010; Wu & Harden, 2015) and may continue long after treatment has ended (Foster, Wright, Hill, Hopkinson, & Roffe, 2009). Cancer patients experience a peak level of distress within the first year after treatment, which might be partially explained by loss of security associated with being in treatment and loss of regular contact with health professionals (Hinnen et al., 2008). Moreover, having a healthy lifestyle expedites recovery and, therefore, is of special importance for survivors. However, many survivors do not have a healthier lifestyle than people without a history of cancer (Mayer et al., 2007): more than half are overweight, less than half comply with physical activity (PA) recommendations, only one fifth adheres to fruit and vegetable recommendations, and one in ten smokes (Bellizzi et al., 2005; Inoue-Choi et al., 2013; LeMasters et al., 2014; Williams et al., 2013).

More than half of the survivors report having unmet information and support needs on how to deal with issues, such as emotional and social support, fear and stress, and treatment and follow-up care (Hodgkinson, Butow, Fuchs, et al., 2007a; Hodgkinson, Butow, Hunt, Pendlebury, Hobbs, & Wain, 2007c; Smith et al., 2013; Willems et al., 2016). Concerning lifestyle, survivors express a need for information and support regarding increasing exercise, improving diet, and smoking cessation (James-Martin, Koczwara, Smith, & Miller, 2014; Pullar, Chisholm, & Jackson, 2012; Willems et al., 2016). To improve the aftercare for cancer survivors, a national guideline for cancer survivorship care was developed in the Netherlands (Comprehensive Cancer Centre the Netherlands, 2011b). This guideline describes the importance of a broad programmatic approach for oncology aftercare in which self-management should be stimulated.

The Internet has become a key source for health-related information for cancer survivors (Chou, Liu, Post & Hesse, 2011; Mayer, Terrin, Kreps, et al., 2007; Warren, Footman, Tinelli, McKee, & Knai, 2014) and has the potential to fill an important gap in cancer care (Leykin et al., 2012). A great advantage of web-based interventions is that they can reach many patients at once and are accessible anytime and anywhere (Lustria, Cortese, Noar, & Glueckauf, 2009). However, due to the broad variety of difficulties experienced and the different characteristics of the survivors, it is challenging to provide individually relevant information and support (Willems et al., 2016). By means of computer tailoring, information

and support can be provided that is adapted to the individual's needs and characteristics, while still reaching large groups.

To provide cancer survivors personalized information and support and stimulating self-management during life after cancer, we developed the web-based computer tailored intervention the *Kanker Nazorg Wijzer* (Cancer Aftercare Guide; KNW). To increase the likelihood of reaching intervention effectiveness, the Intervention Mapping (IM) protocol was used (Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011). This is a systematic, theoretical and empirical-based approach for intervention development. In this article, the development of the KNW according to the steps of IM and the evaluation of the intervention's effectiveness is described.

METHODS/DESIGN

The IM protocol consists of six steps (Bartholomew et al., 2011): (1) a needs assessment of the study population, (2) specification of performance objectives and crossing them with relevant determinants into change objectives, (3) selecting theory-informed intervention methods and practical applications to change the determinants of the health behavior, (4) producing and pretesting program materials, (5) planning program adoption and implementation, and (6) planning for evaluation.

Step 1: Needs assessment

In the needs assessment, the health problem and its impact on the QoL of the at-risk group is assessed (Bartholomew et al., 2011). Understanding cancer survivors' experienced problems and information and support needs is a crucial step in designing interventions that meet survivors' needs (Rutten, Arora, Bakos, Aziz, & Rowland, 2005). Since it was clear that an overall problem among cancer survivors is a reduced QoL (Harrington et al., 2010; Wu & Harden, 2015), the following program goal was stated: At six and 12 months after the start of the KNW program, cancer survivors will report an increased QoL. The needs assessment aimed to disclose which problem areas should be addressed to achieve this goal. We conducted a needs assessment consisting of a literature study, focus group interviews, and a survey. The literature provided an overview of cancer survivors' health-related problems. Anxiety and depression (Brown, Kroenke, Theobald, Wu, & Tu, 2010), fear of recurrence (Simard et al., 2013) fatigue (Prue et al., 2006), sleep problems (Irwin, Olmstead, Ganz, & Haque, 2013), difficulties concerning return to work (Duijts et al., 2014), pain (Paice, 2011), and sexual dysfunction (Chung & Brock, 2013; Lammerink, de Bock, Pras, Reyners, & Mourits, 2012) are frequently identified problems. Furthermore, a healthy lifestyle is associated with positive health outcomes in cancer survivors, while unhealthy lifestyle behaviors may lead to the development of other chronic diseases, new primary tumors, and cancer recurrence (Aleksandrova et al., 2014; Baena & Salinas, 2014; Petersen et al., 2015;

Schmid & Leitzmann, 2014). Unfortunately, a large proportion of cancer survivors do not adhere to recommendations concerning PA, dietary, and smoking behavior (Inoue-Choi et al., 2013; Rock et al., 2012).

Then, we conducted six focus group interviews with 33 cancer survivors using a predefined protocol (Morgan & Krueger, 1998). The topics discussed included experienced problems during survivorship and aftercare needs. Most survivors indicated that they did not know what to expect after treatment or how to cope with their experienced problems. Commonly indicated problems included pain, fear of recurrence, fatigue, concentration problems, insomnia, sadness, insecurity, dealing with social relationships, and work related problems. Many survivors reported difficulties in adhering to PA and diet recommendations. However, PA was seen as an important contributor to recovery. Furthermore, many survivors indicated that they did not always know where they could get aftercare or that the aftercare was not easy accessible. Most survivors expressed the need for more attention from the hospital staff to their psychological, physical, and lifestyle issues. Moreover, the information provided by hospitals concerning aftercare possibilities was described as insufficient. The information on the Internet was described as cluttered and bulky.

Finally, the prevalence and correlates of unmet information and support needs and healthy lifestyle behaviors were investigated in a survey conducted among 255 cancer survivors within the first year after their primary treatment (Kanera et al., 2016a; Willems et al., 2016). The results indicated that almost two-thirds of the survivors reported having unmet needs. Frequently cited unmet needs concerned emotional and social support, help to deal with fear of recurrence, management of healthcare and complications, up-to-date information, management of return to work, increasing exercise, and assistance to quit smoking. While help to eat healthier was not a frequently mentioned unmet need (Willems et al., 2016), adherence to fruit and vegetable recommendations was poor (Kanera et al., 2016a). High education, having breast cancer, participation in support programs, low QoL, high levels of anxiety, and a more negative adjustment to cancer were associated with having more unmet needs in general (Willems et al., 2016). Self-efficacy, attitude, and intention were the strongest correlates of healthy lifestyle behaviors (Kanera et al., 2016a).

Step 2: Matrices of change objectives

Step 2 provides the foundation of the intervention by specifying what will change as a result of the intervention (Bartholomew et al., 2011). For this purpose, performance objectives (POs) are formulated. These are statements of what the program participants need to do to perform the intended health-promoting behavior. Then, important and changeable determinants for the POs are selected. This is necessary for creating change objectives (COs). COs specify what changes in the determinants are needed to make the attainment of the POs most likely.

To specify POs, it needs to be clear what the program outcome should be (i.e., what the program aims to achieve). Based on the needs assessment, the focus of the program was set to significantly reduce experienced problems in seven areas, namely (1) cancer related fatigue, (2) difficulties concerning return to work, (3) anxiety and depression, (4) social relationship and intimacy issues, (5) a lack of PA, (6) a lack of healthy food intake, and (7) difficulties in preparing or maintaining smoking cessation. By effectively managing these problems, improved outcomes in these problem areas are expected, ultimately resulting in a better QoL.

Several POs were formulated for each problem area. An example of a PO for the program outcome "Reduce cancer-related fatigue" is "Say 'no' to a request when it is too much to handle" (see Table 3.1). Then, the most important and changeable behavioral determinants of the POs were selected from theory and literature. The most relevant determinants differed for each problem area. For example, relevant determinants for reducing cancer-related fatigue included knowledge, awareness, attitude, skills, self-efficacy, perceived behavior of others, and outcome expectations. Relevant determinants of engagement in sufficient PA included attitude, self-efficacy, social support, and perceived barriers. Next, COs were stated. Examples of COs for the PO "Say 'no' to a request when it is too much to handle" were "Describe steps to undertake to effectively say 'no' to others" (*knowledge*) and "See fellow survivors acknowledging the importance of saying 'no' to others" (*perceived behavior of others*) (see Table 3.2).

Table 3.1 Performance objectives for the program outcome "Reduce cancer-related fatigue"

PO 1	**Manage daily tasks efficiently**
PO 1.1	Alternate mental and physical activities
PO 1.2	Take small moments of rest divided over the day
PO 1.3	Take adequate measures so not to exceed personal limits
PO 1.4	Say "no" to a request when it is too much to handle
PO 1.5	Make a structured plan of daily activities
PO 2	**Turn non-helpful thoughts about fatigue into helpful thoughts**
PO 2.1	Recognize common non-helpful thoughts about fatigue
PO 2.2	Identify personal non-helpful thoughts
PO 2.3	Generate helpful thoughts
PO 2.4	Replace non-helpful thoughts with helpful thoughts
PO 2.5	Implement personal strategies to cope with rumination
PO 2.6	Use relaxation or mindfulness techniques
PO 3	**Take sleep hygiene measures**
PO 3.1	Identify the type of sleeping problem one is experiencing
PO 3.2	Go to bed and get out of bed at set times every day of the week
PO 3.3	Take care of optimal sleeping conditions
PO 3.4	Identify behaviors that interfere with sleep and replace these with helpful behaviors
PO 3.5	Use relaxation or mindfulness techniques

Table 3.2 Matrix of change objectives for the performance objective "Manage daily tasks efficiently"

Reduce cancer-related fatigue	Knowledge	Awareness	Attitude	Skills and Self-Efficacy	Perceived Behavior of Others	Outcome Expectations
PO.1. Manage daily tasks efficiently		Aw.1. Become aware of planning and structure of own daily activities	At.1. Feel positive about reorganizing daily activities	SSE.1. Feel confident about managing daily activities	PBO.1. See fellow survivors acknowledging the importance managing daily activities	OE.1. Expect that managing daily tasks efficiently can reduce feelings of fatigue
PO.1.1. Alternate mental and physical activities	K.1a. Describe the importance of alternating mental and physical activities K.1b. Recall advice on alternating activities	Aw.2. Become aware whether mental and physical activities are alternated in own daily scheme				OE.2. Expect that alternating mental and physical activities can reduce experiences of fatigue
PO.1.2. Take small moments of rest divided over the day	K.2a. Describe the importance of taking small moments of rest K.2b. Recall advice on taking rest	Aw.3. Become aware whether daily rest is divided in small moments over the day				OE.3. Expect that taking small moments of rest divided over the day can reduce experiences of fatigue
PO.1.3. Take adequate measures to not exceed personal limits	K.3a. Recall possible signals of exceeding personal limits K.3b. Recall effective measures when exceeding limits		At.2. Feel positive about guarding personal boundaries	SSE.2. Feel confident about recognizing signals and taking adequate measures	PBO.2. See fellow survivors acknowledging the importance of not exceeding personal limits	OE.4. Expect that taking adequate measures when exceeding limits can reduce experiences of fatigue
PO.1.4. Say "no" to a request when it is too much to handle	K.4. Describe steps to undertake to effectively say "no" to others		At.3. Feel positive about saying "no" to others	SSE.3. Feel confident about saying "no" to others	PBO.3. See fellow survivors acknowledging the importance of saying "no" to others	OE.5. Expect that others generally accept when receiving "no" to a request
PO.1.5. Make a structured plan of daily activities	K.5. Summarize advice on making a structured plan			SSE.4. Demonstrate ability of making an efficient plan by incorporating advice in the new plan		OE.6. Expect that making a new plan will help in dealing with fatigue

Step 3: Selecting theoretical methods and practical applications

In this step, theoretical methods and practical applications for achieving the COs and POs are selected (Bartholomew et al., 2011). A theoretical method is a technique or process for influencing change in the determinants of the targeted behavior. A practical application is a specific technique for practical use of a theoretical method. For example, by means of self-monitoring of behavior (*method*) we aimed to change cancer survivors' awareness of how they scheduled their daily activities (*determinant*) by encouraging them to register their daily activities for five to seven days (*practical application*) (see Table 3.3). Methods and applications were derived from literature, focus group interviews, and existing interventions (see Step 4, Reviewing Available Materials).

Several methods were used in the KNW, such as feedback, personalizing risk, consciousness raising, belief selection, modeling, active learning, persuasive communication, argumentation, goal setting, action planning, and implementation intentions. Two methods formed the core of the KNW: *tailoring* and *skills training for self-management*. These two methods were used throughout the entire intervention and were combined with the other methods to change the determinants of the targeted behaviors.

Tailoring

Tailoring is a technique in which information is provided that is adapted to the personal characteristics, circumstances, beliefs, motivations, and behavior of the receiver (de Vries & Brug, 1999; Noar, Benac, & Harris, 2007). Thus, by means of tailoring, personalized advice can be provided that suits the cancer survivors' needs. Overall, tailoring is proven to be an effective technique in health promotion and communication (de Nooijer, Lechner, Candel, & de Vries, 2004; Kuijpers et al, 2013; Noar et al., 2007; Oenema et al., 2008; Peels et al., 2013). Since the information is personalized, less redundant information is provided, attention is increased, information is more thoughtfully processed, and behavior change or maintenance is better facilitated (Brug, Oenema, & Campbell, 2003; de Vries & Brug, 1999; Noar et al., 2007; Rimal & Adkins, 2003). The KNW starts with a screening questionnaire that enables tailoring. Based on their answers, participants receive feedback about which of the seven problem areas deserve their attention (see also Step 4, Screening Questionnaire). When selecting a problem area that the participant wants to work on, the information on that problem is tailored further, eventually resulting in a personalized action plan.

Skills training for self-management

Self-management is an iterative process that comprises observation of one's behavior (monitoring), making judgments of behavior based on the observation (evaluation), setting goals, and choosing and applying strategies to achieve these goals (action) (Bartholomew

et al., 2011; Clark, 2003; Scheier & Carver, 2003). The principles of problem-solving therapy (PST; D'Zurilla & Nezu, 2007; Nezu, Nezu, Houts, Friedman, & Faddis, 1999) and cognitive behavioral therapy (CBT; Gielissen, 2007) were used as applications to increase cancer survivors' self-management skills. PST and CBT for cancer patients and survivors have been found effective for, amongst others, improving symptom management (Doorenbos et al., 2005; Mishel et al., 2002), mental health and QoL (Allen et al., 2002; Fors et al., 2011), dealing with uncertainty (Mishel et al., 2002), fatigue (Goedendorp, Gielissen, Peters, Verhagen, & Bleijenberg, 2012; Goedendorp, Gielissen, Verhagen, & Bleijenberg, 2009; Heins, Knoop, Burk, & Bleijenberg, 2013) and insomnia (Garland et al., 2014) and reducing psychological distress (Nezu, Nezu, Felgoise, McClure, & Houts, 2003).

Table 3.3 Methods and applications to change the determinants of the performance objective "Manage daily tasks efficiently"

Determinant	Theoretical methods	Practical applications
Knowledge	• Chunking • Elaboration • Cues	• Advice provided is divided in several topics and is summarized when participants make their own planning. • After providing advice, personally relevant messages encourage participants to incorporate this advice with their situation. • Cues are provided that help saying "no" to a request and to recognize when personal limits are exceeded.
Awareness	• Consciousness raising • Self-monitoring of behavior	• Cancer survivors are encouraged to register their daily activities for five to seven days. After registration, survivors are given advice on effectively planning their day, asked to compare their plan with the advice received, and encouraged to adjust their plan to meet this advice.
Attitude	• Arguments	• Cancer survivors are given arguments why efficiently planning daily activities is beneficial for reducing fatigue, why guarding personal boundaries is important, and why saying "no" to some requests is important.
Skills and Self-Efficacy	• Active learning • Action planning	• Cancer survivors are encouraged to make their own weekly plan using the advice given. • Cancer survivors are encouraged to make a list of personal signals indicating that limits are exceeded and select adequate measures for each signal. • Cancer survivors are encouraged to make their own action plan for when they are in a situation in which they want to say "no" to a request.
Perceived Behavior of Others	• Modeling	• Cancer survivors are provided with narratives of other survivors who are further along in their recovery process. In these narratives the importance and effectiveness of planning daily activities, setting personal boundaries, and saying "no" to others is explained.
Outcome Expectations	• Persuasive communication • Active learning • Modeling	• By providing information from different sources (e.g., peers) on managing daily activities and by making assignments, cancer survivors are encouraged to expect that fatigue can be dealt with when taking adequate measures.

PST comprises five steps in which the patient (1) needs to adopt a positive attitude towards facing the problem, (2) defines what the problem exactly is, (3) makes a list of alternatives to tackle the problem, (4) predicts the benefits and consequences of each alternative, and (5) implements the best alternative in daily life and evaluates the result (D'Zurilla & Nezu, 2007). In the KNW, each problem area is addressed following the structure of PST; that is, identifying the problem and selecting a goal, getting informed of different solutions, making a personalized action plan, and trying out the action plan and evaluating the progress.
The basic principles of CBT are covered by providing psycho-education and giving assignments, such as monitoring behavior or thoughts, challenging dysfunctional cognitions, and encouraging patients to set new goals. In addition, elements were used from a treatment protocol proven effective for treating cancer-related fatigue among cancer survivors (Gielissen, 2007). The protocol links six factors to fatigue: (1) poor coping with cancer, (2) fear of cancer recurrence, (3) dysfunctional cognitions (4) dysregulation of sleep, (5) dysregulation of activity, and (6) low social support. All these factors are addressed in the KNW.

Step 4: Producing program components and materials

With the end products of the previous steps, the program components and materials were produced. This included describing the program scope and sequence, preparing design documents, reviewing available materials, and developing and testing the program materials (Bartholomew et al., 2011).

Scope and sequence

The KNW (http://www.kankernazorgwijzer.nl) covers seven self-management training modules. The modules Fatigue, Return to Work, Mood (i.e., anxiety and depression), and Relationships mainly cover psychosocial and mental health related issues, while the modules Physical Activity (PA), Diet, and Smoking cover lifestyle-related issues. The modules are interrelated. For example, within the Fatigue module, participants receive the advice to also visit the PA module if there is an indication that the participant is getting too little PA. As discussed in Step 3, the sequence within the modules is based on PST (D'Zurilla & Nezu, 2007). In general, the modules consist of four components divided over two sessions. In the first session, participants identify their problem, select a goal and receive psycho-education and assignments on how to deal with their problem, and personalize their goal through action plans. After 30 days, participants are invited for a second session in which they can evaluate the progress of their goal. If successful, participants are encouraged to maintain their behavior. Otherwise, participants are encouraged to try again, try another solution, or adjust their goal and receive additional advice on how to deal with difficult situations. Furthermore, all modules provide links to other relevant and reliable websites.

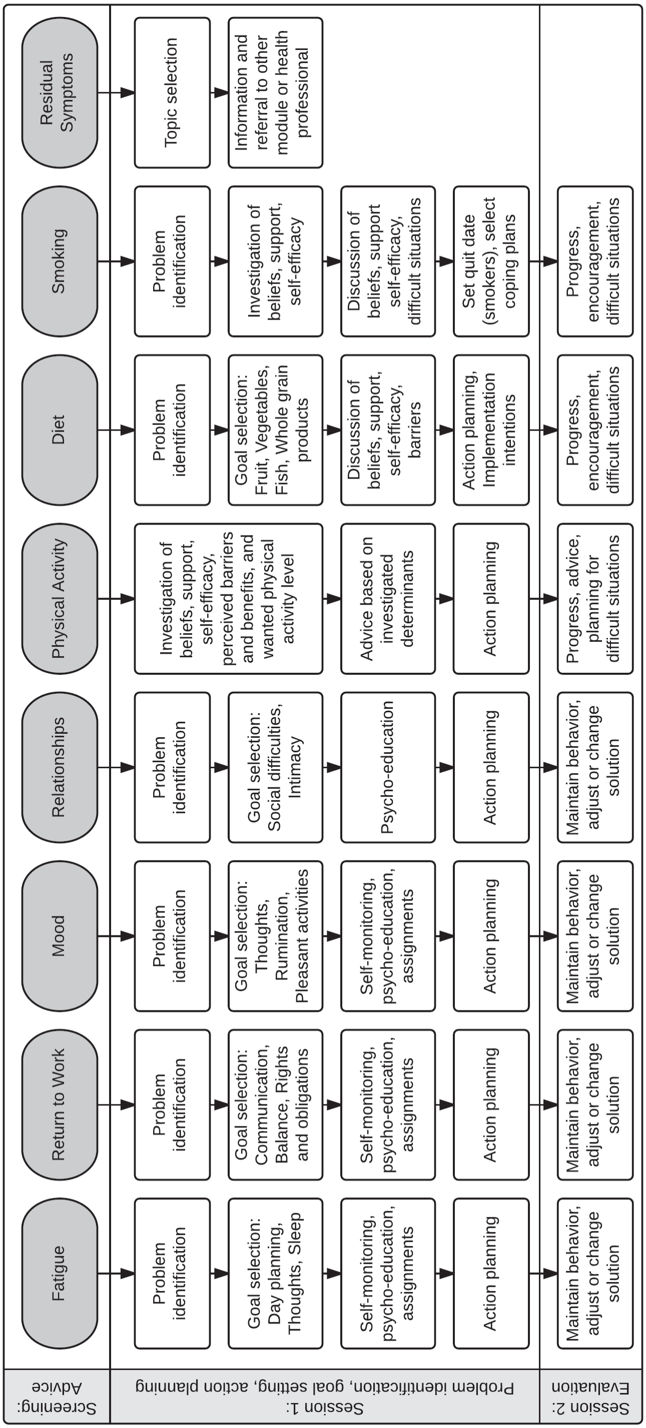

Figure 3.1 Overview of the scope and sequence of the modules

Participants of the focus groups (see Step 1) expressed the need to be informed about commonly experienced complaints after cancer treatment. Therefore, an additional module covering residual symptoms from cancer treatment was added to the KNW. In this module, general information is given on the most common physical complaints experienced after primary treatment, tips are given on how to deal with these symptoms, and advice is given to seek medical assistance for more information or help. For an overview of the scope and sequence of all modules, see Figure 3.1.

To keep participants involved in the program, several types of e-mails were sent. First, participants received reminder e-mails when they completed the screening questionnaire but did not visit any of the modules. Second, participants received an e-mail to invite them to the second session of a module. Third, participants received a postcard in spring wishing them Happy Easter and an eCard around the Holidays wishing them Happy Holidays. Fourth, monthly news items were placed on the website in which professionals from different fields talk about cancer recovery (see Step 4, Video Material). Participants received an invitation e-mail to see the latest news item.

Suggestions from the target group

During the focus group interviews (see Step 1), the preferences for the look and feel of the future program were discussed. First, survivors suggested messages to be framed positively and that the program should have a calm and friendly appearance (see Figure 3.2).

Second, survivors indicated that they preferred an open and unrestrictive program. Therefore, the KNW is programmed in such a way that users can choose which modules of the intervention they want to follow, even if they get the advice that they are doing well in this area. Third, survivors mentioned that the intervention should be easy to use. Therefore, a website with clear and distinctive buttons was designed with an emphasis on preventing an overload of information. Finally, it was suggested that the written information should be supported with video material. We adhered to this by providing informational videos from professionals from different fields. Also, there was a high demand for videos of fellow survivors, who were further into their recovery process, discussing their experiences of their life after cancer treatment. Therefore, we interviewed eight former patients discussing their cancer recovery and giving advice on how to deal with certain issues (see Step 4, Video Material).

Reviewing available materials

Before developing the program materials, available program materials of others were reviewed for a possible match with the COs, methods and applications of the KNW (Bartholomew et al., 2011). There were some computer tailored interventions from which elements were usable for the modules of the KNW. For the PA module, we shortened

and adjusted the Active Plus intervention (Peels et al., 2012; Peels, van Stralen, et al., 2014; van Stralen et al., 2008; van Stralen, de Vries, Mudde, Bolman, & Lechner, 2009) to meet the characteristics of our target group. We also used elements from computer tailored interventions on smoking cessation (Stanczyk, Bolman, Muris, & de Vries, 2011; Te Poel, Bolman, Reubsaet, & de Vries, 2009; Van Berkel, 2000,) and diet (Oenema, Brug, & Lechner, 2001; Springvloet, Lechner, & Oenema, 2014; van Keulen et al., 2008; Walthouwer, Oenema, Soetens, Lechner, & de Vries, 2013). As mentioned in Step 3, the Fatigue module was based on a protocol for treating cancer-related fatigue (Gielissen, 2007).

Figure 3.2 The appearance of the KNW

The intervention

Screening questionnaire

The KNW starts with a screening questionnaire measuring several concepts, including fatigue, work limitations, psychological distress, social support, PA, food intake, and smoking behavior (see Step 6, Measurements). Based on their answers, participants receive personal advice about which modules deserves their further attention. For this, a thermometer is used as visual aid (see Figure 3.3). "Green" advice indicates that the participant is doing well in this area and visiting the corresponding module is not necessary. "Orange" advice indicates that the participant is doing reasonably well, but there still is room for improvement. "Red" advice indicates that the participant is strongly advised to visit the corresponding module.

Modules

Fatigue

In the Fatigue module, cancer-related fatigue is addressed. Based on the answers of the screening questionnaire, participants receive a description of the type of fatigue they are most likely experiencing. Participants receive an improvement proposal, comprising the themes day plan, fatigue-related thoughts, sleeping behavior, feelings of anxiety or depression, relationships, and PA. When participants want to work on PA, relationships, or feelings of anxiety and depression, they are referred to the Mood, Relationships, and PA modules, respectively.

Figure 3.3 After screening, participants are advised which modules deserve their attention

The theme "Day Plan" discusses the importance of a structured day plan. Participants are encouraged to monitor their daily activities for five to seven days. Then, psycho-education and assignments are given concerning planning activities and rest, not to exceed personal limits, and saying "no" to requests. Finally, participants are encouraged to make a weekly plan.

The theme "Thoughts About Fatigue" discusses beliefs concerning fatigue that are fatigue enhancing. Psycho-education and assignments are given on recognizing and identifying non-helpful thoughts. Participants are encouraged to register their own non-helpful thoughts for one week. Then, these thoughts are challenged by discussing their credibility

and usefulness and advice is given on how to replace these thoughts with helpful thoughts. Furthermore, advice is given on how to deal with rumination. Finally, to deal with stress related to dysfunctional cognitions, information and assignments are given concerning relaxation and mindfulness.
The theme "A Good Night's Sleep" discusses participants' sleeping behavior. Participants are encouraged to monitor their sleep and wake times for one week. Then, psycho-education and assignments are given concerning types of sleeping problems, the importance of a consistent sleep-wake pattern, and sleeping hygiene. Also, information and assignments are given concerning relaxation and mindfulness.

Return to Work

In the Return to Work module, difficulties and rights and obligations concerning returning to work are discussed. Based on the answers of the screening questionnaire, participants receive an overview of their indicated problems concerning return to work and are given the opportunity to further specify these problems. Then, participants select a goal that they want to achieve (e.g., learning to ask for help). Depending on the chosen goal, participants are advised to continue with one of the three themes: Communication, Balance, and Rights and Obligations.
The theme "Communication" discusses the preparation of difficult, work-related conversations. Psycho-education and assignments are given on preparing work-related conversations with different persons, such as one's occupational physician, supervisor, or colleague. Advice is given on, amongst others, how to indicate possibilities and limitations with regard to work tasks, asking for help, dealing with incomprehension from the manager or colleagues, or preparing a job application. Moreover, advice and assignments are given on how to increase feelings of confidence and decrease feelings of stress in difficult interactions.
The theme "Balance" focuses on finding a balance between the participants' work abilities and their workload. Participants are encouraged to monitor for several workdays how much energy certain work-related tasks cost. Then, psycho-education and assignments are given concerning planning the workday, not to exceed personal limits, making adjustments at work, dealing with limited concentration and memory problems, relaxation, and thinking positively.
The theme "Rights and Obligations" provides information on cancer survivors' rights and obligations concerning work with a long-term illness. Information is provided on topics such as re-integration, unemployment, searching for a new job, social welfare payments, insurances, legal advice, or rights on facilities to perform one's job properly, given the limitations caused by the disease or treatment.

Mood

The Mood module focuses on feelings of anxiety and depression. More specifically, the module discusses common anxiety and depression provoking thoughts and how to cope with these thoughts more effectively. Based on the answers of the screening questionnaire, participants receive feedback on their current state of anxiety, depression, and adjustment to cancer. When there is an indication that the participant is experiencing severe levels of psychological distress, a recommendation is given to visit one's general practitioner to get a referral for help. In the module, participants first set a goal they want to achieve (e.g., to reduce feelings of sadness). Then, psycho-education and assignments are given concerning non-helpful or anxiety provoking thoughts, such as feelings of failure or fear of cancer recurrence. Participants are encouraged to monitor their inefficient thoughts for one week. Then, these thoughts are challenged by discussing their credibility and usefulness and advice is given on how to replace these thoughts with helpful thoughts. Furthermore, advice and assignments are given concerning planning pleasant activities, how to deal with rumination, and how to reduce feelings of anxiety or sadness by means of relaxation and mindfulness.

Relationships

The Relationships module addresses coping with difficult social situations and intimacy problems. Difficult social situations are discussed, such as receiving inadequate help from others, social isolation, experiencing social pressure, and talking about having had cancer. Based on the answers of the screening questionnaire, participants receive an overview of social situations in which they wish change. After selecting such a social situation, psycho-education is given on how to constructively deal with this situation.

Concerning intimacy, psycho-education is given on discussing intimacy and sexuality with significant others and how to cope with sexuality with respect to physical and functional changes due to cancer treatment. Coping with physical and functional changes is tailored to gender. For example, men receive information on how to cope with issues such as erectile dysfunction or dry orgasms, while for women advice is given on how to cope with issues such as menopausal symptoms or vaginal problems.

Physical Activity

In the PA module, participants are encouraged to increase their level of PA. Based on the answers of the screening questionnaire in combination with the Dutch PA guidelines, participants receive feedback on their own level of PA and to which extent it reaches the recommended level. Then, participants are encouraged to set a goal, for example, increasing PA during commuting, daily activities, leisure time, or sports. Subsequently, advice is given

based on the participant's beliefs about the pros and cons of exercising, perceived barriers and benefits, self-efficacy, and social support. Next, participants are encouraged to make a personal exercise plan. The module provides information on specific exercises and sport activities tailored to participant's individual situation, physical limitations and social cognitive determinants.

Diet

The Diet module focuses on increasing fruit, vegetables, whole grain bread, and fish consumption. Based on the answers of the screening questionnaire in combination with the Dutch nutritional guidelines, participants receive feedback on their dietary habits and the extent to which it reaches the recommended level. The module subsequently provides a standard, non-personalized overview of a healthy diet, including desirable and undesirable foods and an indication of the recommended servings. Afterwards participants are encouraged to set one or two goals, for example, eating two pieces of fruit per day or eating 200 g of vegetables per day. Subsequently, dietary advice is given, personalized to the participant's individual situation, experienced medical or treatment related problems, and the participant's attitudes, self-efficacy, and social support toward performing the desired dietary behavior.

Smoking

The Smoking module is developed for smokers to stimulate them to refrain from smoking and for former smokers to prevent relapse. Based on the answers of the screening questionnaire, participants' current smoking behavior is discussed. Smokers are encouraged to quit and to set a quit date. Advice is given on how to anticipate risky situations for a lapse and how to deal with withdrawal symptoms. Smokers are encouraged to develop an individual coping plan to prepare their quit attempt and to deal with difficult moments to maintain abstinence. Former smokers also receive advice based on their individual situation and social cognitive determinants, aimed at the prevention of relapse. They are also encouraged to develop coping strategies to prevent relapse.

Residual Symptoms

In the Residual Symptoms module, brief information is given about complaints, such as pain, lymphedema, osteoporosis, or neuropathy. If a certain topic is covered in one of the other modules, referral to the respective module is also given. Next to some basic tips on how to deal with these symptoms, participants are given advice to contact their physician or other health professional when they experience serious problems.

Other website elements

Personal page. On the Personal Page participants can find an overview of the personal advice they received from the screening questionnaire and the modules. Also, the Personal Page contains a few instructional videos on how to use the KNW (see Figure 3.4).

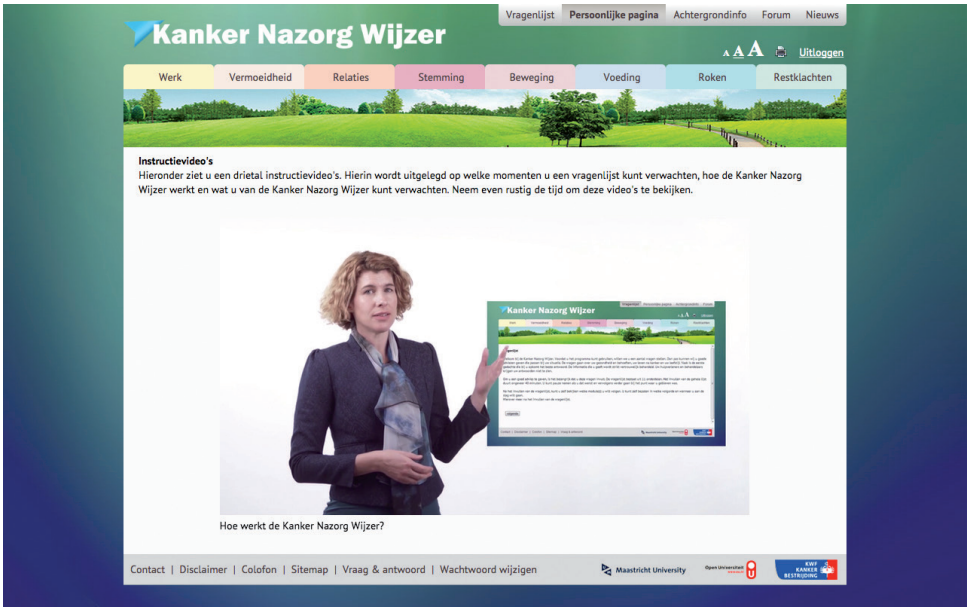

Figure 3.4 Example of an instructional video explaining how to use the KNW

Video material

The use of videos is an important component of the KNW. Text messages accompanied with video are more appreciated and better recalled than text messages only (Bol et al., 2013; Idriss, Alikhan, Baba, & Armstrong, 2009). There are four types of videos implemented. First, *instructional videos* explain what participants can expect from the KNW and how they should navigate the program. Second, *videos of fellow survivors* were included for which we interviewed eight cancer survivors who were further along in their recovery process and willing to share their experiences of their life after cancer treatment and give advice to deal with certain issues. Since men and women interviewed were from different age groups and recovering from different types of cancer, it is more likely that participants identify with one of these role models. Third, *videos of professionals* were included for which we interviewed a sexologist and two clinical psychologists. These professionals give psycho-education and advice from clinical practice. Fourth, with monthly *news items* participants were provided with extra information on specific areas. We interviewed professionals from

different fields, talking about topics such as exercise, diet, return to work, anxiety and depression, lymphedema, and peer support groups. With these news items, we aim to keep the participants involved in the KNW by referring them to the module that is related to the topic discussed in the news item.

Forum

The KNW has a forum where fellow survivors can meet and ask each other or members of the KNW team questions. Participants are kept anonymous and the KNW team monitors the forum to control for advice contradicting the advice given in the modules.

Pretesting and revising

The KNW was pretested among 13 cancer survivors. In general, the appearance and content of the KNW was highly appreciated. The modules were evaluated positively (M = 7.6, range = 1-10). Particularly, the videos of fellow survivors and professionals were highly rated (M = 8.0, range = 1-10). The mean scores for understanding, usefulness, reliability, applicability, completeness, and appearance of the KNW ranged from 3.3 to 3.7 (range = 1-4) and, therefore, were also highly appreciated. Some of the texts were evaluated as fairly long. Consequently, an editor reviewed and edited the text on readability and length. Furthermore, the tailored advice was evaluated to be of great value. While the tailored messages were computer generated, some participants initially thought that a person provided these messages. Although this demonstrated the power of tailoring, it also confused the participant when an answer did not fully match his or her expectations. Further, while the aim of the KNW is to stimulate participants to create their own solutions, some participants expected to receive personalized solutions to their problems. To address these issues, we included the previously mentioned instructional videos to explain how the KNW works and what participants can expect. After some final adjustments, the KNW was ready for implementation and effectiveness testing.

Step 5: Adoption and implementation

In the fifth step, a plan for program adoption and implementation was developed (Bartholomew et al., 2011) in the context of testing the effectiveness of the KNW in a randomized controlled trial (RCT). We created a network with representatives (e.g., department heads, oncologists, research nurses, and nurse practitioners) from several hospitals' outpatient clinics in internal medicine, oncology, gynecology, urology, and the breast clinic. 45 hospitals in the Netherlands were contacted for assistance in the recruitment. 21 hospitals agreed to participate, with 21 hospitals eventually participating in patient recruitment. Reasons for refusing participation included: hospital was already participating

in other research projects, lack of time or excessive workload, too few staff members to recruit participants, or insufficient number of patients who met the inclusion criteria. Creating this network was a very time consuming process; it easily could take more than half a year from the moment of contacting a representative of a clinic until staff members began recruiting participants. Next, maintaining contact with multiple hospitals required good planning. To keep the staff members involved, we send out monthly newsletters with updates of the research project. Also, we regularly send thank-you cards. To conclude, timely planning of program adoption and implementation is essential.

Step 6: Planning for evaluation

In the final step, a plan for the effect and process evaluation of the intervention was developed. While the effect evaluation describes the differences in outcomes between the participants who were and were not exposed to the KNW, the process evaluation aims to get insight into the use and appreciation of the intervention (Bartholomew et al., 2011). For the evaluation of the KNW, an RCT comparing the intervention group with a waiting list control group was conducted. The RCT is approved by the Medical Ethics Committee of the Atrium Medical Centre (NL41445.096.12) and is registered in the Dutch Trial Register (NTR3375).

Participants

Patients were eligible for participation if they were 18 years or older, they had been diagnosed with any cancer type, primary treatment (surgery, chemotherapy, and/or radiation therapy) had been completed successfully for at least six weeks but no more than 52 weeks, there was no sign of recurrence in the latest follow-up visit, they were able to read and speak Dutch, and there was no serious medical, psychiatric, or cognitive illness that would interfere with participation. Computer literacy was not an explicit inclusion criterion, since the hospital staff was not able to screen for this. We expected that patients who were not computer literate would not participate in the study.

Design and procedure

Staff members of 21 hospitals (see Step 5) recruited patients from November 2013 through June 2014. The recruitment period varied per hospital. Patients were selected either during follow-up visits to the hospital or from reviews of patients' files. Oncologists, research nurses, and nurse practitioners from the outpatient clinics internal medicine, oncology, gynecology, urology, and breast clinics invited patients who met the inclusion criteria to participate by giving them an information package during a follow-up visit or sending the package to them following review of the patient's files. The information package included: (1) a letter

with trial information and a username and password for first login, (2) an informed consent form with return envelope, (3) an information brochure concerning Medical Research, (4) a short manual on how to use the KNW, and (5) a small card with contact details and space where participants could write down their new username and password. A reminder was send after two weeks. Patients who agreed to participate were requested to sign the informed consent form and return it to the Open University of the Netherlands. Patients who participated in the research but did not return the consent form were contacted to do so. If they did not return the informed consent after several reminders, they were excluded from evaluation.

After online registration, participants were randomly assigned to either the intervention group or the waiting list control group. Both groups had to fill in a questionnaire at four time points: At baseline (T0), after three months (T1), after six months (T2), and after 12 months (T3). T1 aimed to measure possible mediating variables, while T2 and T3 aimed to measure the short- and long-term effectiveness of the intervention respectively. The intervention group had six months access to the KNW directly after baseline. The waiting list control group had access to the intervention after T3.

Several methods were used to increase the response rate. First, several automated e-mail reminders were sent for each measurement. Second, in the baseline measurement, participants could leave their telephone number so we could contact them concerning the research. When we noted that participants had not reacted to the e-mail reminders, we contacted them through telephone as a final reminder. Third, in the e-mail reminders participants were explained that they would receive a small token of appreciation at the end of the trial. That is, participants received a book voucher with a value of € 10 for trial participation.

Measurements

The primary outcomes for the evaluation of the KNW comprise psychosocial well-being and lifestyle outcomes. Measuring psychosocial well-being comprised assessment of QoL (Aaronson et al., 1993), psychological distress (Bjelland, Dahl, Tangen Haug, & Neckelmann, 2002; Zigmond & Snaith, 1983), mental adjustment to cancer (Watson & Homewood, 2008), fatigue (Vercoulen et al., 1994), work limitations (Burton, Chen, Conti, Pransky, & Edington, 2004; Burton, Pransky, Conti, Chen, & Edington, 2004; Lerner et al., 2001), and social support (van Sonderen, 2012). Measuring lifestyle comprised assessment of PA (Wendel-Vos, Schuit, Saris, & Kromhout, 2003), food consumption (Van den Brink et al., 2005), and smoking behavior (Mudde et al., 2006). Secondary outcomes included measures that were assumed to moderate or mediate the effects of the primary outcomes, such as resilience (Smith et al., 2008), self-control (Tangney, Baumeister, & Boone, 2004), personal control (Moss-Morris et al., 2002), problem solving skills (D'Zurilla, Nezu, & Maydeu-Olivares, 2002; Dreer et al., 2009),

and several background characteristics (e.g., age, gender, education, employment status, and disease and treatment history). Finally, we measured cancer survivors' unmet needs (Hodgkinson et al., 2007b).

Power calculation

Sample size calculations were based on the outcomes of QoL and psychological distress, since these were expected to be the most difficult to change. Calculations showed that 144 patients per group were required to compare means for these outcomes between groups with a power greater than .80, one sided with an alpha of .10. This was based on an expected effect size of .30 and, since recruitment would be through hospitals, a correction for multilevel analyses (intracluster correlation coefficient = .005, design effect = 1.15). With an expected dropout rate of 20% during the study, this meant 376 patients needed to be included at baseline. With 231 patients included in the intervention group and 231 patients in the waiting list control group at baseline, this target has been achieved.

DISCUSSION

The aim of this paper was to describe the systematic development and the study design for evaluation of the KNW, a web-based computer tailored intervention aimed at providing psychosocial and lifestyle support during life after cancer. The intervention aims to reduce cancer survivors' experienced problems in seven areas: (1) cancer-related fatigue, (2) difficulties concerning return to work, (3) anxiety and depression, (4) relationships and intimacy issues, (5) a lack of PA, (6) a lack of healthy food intake, and (7) difficulties in preparing or maintaining smoking cessation. By reducing the experienced problems in these areas, it is expected that this ultimately will result in a higher QoL. The intervention was developed using the IM protocol (Bartholomew et al., 2011). This protocol supports health promotion program planners in systematically developing a theory and evidence-based program, and, as a result, increasing the likelihood of its effectiveness.

Beside the systematic development, the KNW has several other strengths. First, since the KNW concerns a web-based intervention, it can reach many patients at once and is accessible anytime and anywhere (Lustria et al., 2009). Second, by means of tailoring, information is more personally relevant. Therefore, it is more likely that this information increases attention, is more thoughtfully processed, and facilitates behavior change or maintenance (Brug et al., 2003; de Vries & Brug, 1999; Noar et al., 2007; Rimal & Adkins, 2003). Third, the use of video material to accompany the text also increases the likelihood that the information is remembered and recalled (Bol et al., 2013; Idriss et al., 2009). Fourth, as universal methods, the KNW uses the principles of PST (Nezu et al., 1999) and CBT (Gielissen, 2007) to stimulate cancer survivors to learn self-management techniques that they also can

apply in other situations. Fifth, elements of the KNW are based on existing interventions that already have been proven effective. Sixth, by evaluating the KNW through an RCT, we will be able to draw conclusions of the intervention's effectiveness.

However, there are also some weaknesses that should be mentioned. First, the intervention contains much written information. Since PST and CBT are quite extensive forms of therapy, it was a challenge to reduce the amount of information while still holding to the theoretical framework of these methods. Much information might particularly be a problem for people with low health literacy (Verkissen et al., 2014), since they might not be able to adequately process all the information given. To avoid an overload of information, participants could freely choose which modules to visit, which steps to follow, and which assignments to make. Participants could stop anytime and continue at the point where they stopped. The use of video material might also be beneficial in the understanding of the information for survivors with low health literacy (Davis, Williams, Marin, Parker, & Glass, 2002; Hart, Blacker, Panjwani, Torbit, & Evans, 2015). Second, although the KNW is based on PST and CBT, there is no real patient-therapist interaction. Except by self-report, it is not possible to investigate whether the learned skills were applied in the right way (Finfgeld, 1999). In addition, it is difficult to anticipate the experienced emotions and non-verbal behavior of the participant or to give further explanation on why a certain advice is given. With computer tailoring, it is only possible to anticipate reactions that are highly expected. Third, while a greater proportion of cancer survivors are elderly (The Dutch Cancer Society, 2011), this group in general has fewer computer skills (AGE Platform Europe, 2008), and is less likely to use the Internet as a source for health-related information (Chou et al., 2011) than younger cancer survivors. To address this problem, the KNW was developed in such way that it is relatively easy to use. The invitation for participation was accompanied with a quick guide for using the KNW and the program provides instructional videos explaining how the KNW works. Also, support through telephone and e-mail is provided. It should be noted that this is only a temporary issue, as computer skills and use are increasing rapidly, especially among older adults (Statistics Netherlands, 2016).

In conclusion, the KNW is a theory and evidence based web-based computer tailored intervention that seems a promising tool to support cancer survivors to cope with cancer-related issues during life after treatment. The results of the RCT, which will be presented in other papers, will provide more insight into the effectiveness and working mechanisms of the KNW and its appreciation by its users.

PART II

Intervention process evaluation

Use and appreciation of a tailored self-management eHealth intervention for early cancer survivors. Process evaluation of a randomized controlled trial

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ABSTRACT

Background

A fully automated computer tailored web-based self-management intervention, Kanker Nazorg Wijzer (Cancer Aftercare Guide), was developed to support early cancer survivors to adequately cope with psychosocial complaints and to promote a healthy lifestyle. The KNW self-management training modules target the following topics: return to work, fatigue, anxiety and depression, relationships, physical activity, diet, and smoking cessation. Participants were guided to relevant modules by personalized module referral advice that was based on participants' current complaints and identified needs. The aim of this study was to evaluate the adherence to the module referral advice, examine the intervention module use and its predictors, and describe the appreciation of the intervention and its predictors. Additionally, we explored predictors of personal relevance

Methods

This process evaluation was conducted as part of a randomized controlled trial. Early cancer survivors with various types of cancer were recruited from 21 Dutch hospitals. Data from online self-report questionnaires and logging data were analyzed from participants allocated to the intervention condition. Chi-square tests were applied to assess the adherence to the module referral advice, negative binominal regression analysis was used to identify predictors of module use, multiple linear regression analysis was applied to identify predictors of the appreciation, and ordered logistic regression analysis was conducted to explore possible predictors of perceived personal relevance.

Results

From the respondents (N = 231; mean age 55.6, SD 11.5; 79.2% female), 98.3% were referred to one or more KNW modules (M = 2.9, SD = 1.5), and 85.7% visited at least one module (M =2.1, SD = 1.6). Significant positive associations were found between the referral to specific modules (range 1-7) and the use of corresponding modules. The likelihood of visiting modules was higher when respondents were referred to those modules by the module referral advice. Predictors of visiting a higher number of modules were a higher number of module referrals (β = .136, p = .009) and a higher perceived personal relevance (β = .150, p = .014), while having a partner was significantly related with a lower number of modules used (β = -.256, p = .044). Overall appreciation was high (M = 7.5, SD = 1.2; scale 1-10) and was significantly predicted by a higher perceived personal relevance (β = .623, p = .000). None of the demographic and cancer-related characteristics significantly predicted the perceived personal relevance.

Conclusions

The Cancer Aftercare Guide in general and more specifically its modules were well used and highly appreciated by early cancer survivors. Indications were found that the module referral advice might be a meaningful intervention component to guide the users in following a preferred selection of modules. These results indicate that the fully automated web-based Cancer Aftercare Guide provides personal relevant and valuable information and support for early cancer survivors. Therefore, this intervention can complement usual cancer aftercare and may serve as a first step in a stepped-care approach.

BACKGROUND

Recovery from cancer and its treatment can be challenging for cancer survivors. A variety of physical, psychosocial, and lifestyle difficulties might impede the resumption of previous daily life activities (Bluethmann et al., 2015). Cancer aftercare guidelines for oncology professionals recommend paying attention to the early detection and recognition of psychological distress, fatigue, pain, problems with daily activities, lifestyle risks, and also to stimulating self-care within the first year after completing the primary curative cancer treatment (Comprehensive Cancer Centre the Netherlands, 2011b; Runowicz et al., 2016). Further, due to the aging population and improved cancer care, the population of cancer survivors is growing while complaints, needs, and preferences of cancer survivors can vary individually over the different subjects and time (Given & Given, 2013; Kanera et al., 2016a; The Netherlands Cancer Registry, 2017; Willems et al., 2016). For these reasons, fully automated, computer tailored web-based cancer aftercare interventions may be suitable for providing a large number of cancer survivors with personalized advice at relatively low costs (Kohl, Crutzen, & de Vries, 2013). Moreover, online solutions fit well with the increasing numbers of cancer survivors who search the Internet for health-related information, especially with those survivors who do not seek face-to-face guidance or treatment (Chou et al., 2011; Ritterband & Tate, 2009). Web-based interventions might be appropriate to be integrated as a first step in stepped care approach as it offers a low intensive intervention first before referring to interventions that are more intensive. Such first-step, low-intensive interventions might be sufficient to meet the personal needs of a large proportion of survivors with relatively mild complaints and are less costly (Krebber et al., 2012). In addition, web-based interventions can comprise relevant information as written text, videos, animations, interactive features, hyperlinks, while personalization of the content is possible by applying computer tailoring (Broekhuizen et al., 2012; de Vries & Brug, 1999; Noar et al., 2007).

The web-based intervention *Kanker Nazorg Wijzer* (Cancer Aftercare Guide, KNW) is a fully automated intervention that aims to increase survivors' quality of life (QoL) by providing psychosocial support as well as promoting positive lifestyle changes, and targets cancer

survivors of any type of cancer (Willems et al., 2015). The KNW consists of seven self-management training modules covering the topics return to work, fatigue, anxiety and depression, social relationship and intimacy issues, physical activity (PA), diet, and smoking cessation (see Figure 4.1), supplemented with one general information module on residual symptoms.

Based on the responses to a screening questionnaire, cancer survivors receive personalized advice on which KNW modules are most relevant for them to use. This Module Referral Advice (MRA) is designed in a fashion analogous to traffic lights as displayed in Figure 4.2. This MRA aims to guide participants through the broad-scoped KNW portal, based on experienced complaints and identified needs, as assessed by the screening questionnaire. The KNW has been shown to be effective in reducing fatigue and depressive symptoms and in improving quality of life domains (i.e., emotional and social functioning; Willems et al., 2017a). In addition, strong indications were found that KNW users are engaged in more moderate PA, and have a higher intake of vegetables, fruits, and fish six months after they started using the KNW (Kanera, Bolman, Willems, Mesters, & Lechner, 2016b). Besides assessing the effects of the KNW, it is important to understand how this complex intervention was used and appreciated by the participants, whether use and appreciation was predicted by certain user characteristics, and to evaluate relevant key intervention components (Brouwer et al., 2011; Hulscher, Laurant, & Grol, 2003; Kohl et al., 2013; Linnan, 2002). Moreover, it is essential to examine specifically whether the provided information was perceived as personally relevant in order to evaluate the computer tailoring.
Previously published web-based interventions in the areas of lifestyle, mental health and chronic conditions differ with regard to the number of (cancer-related) topics, the composition of the target group, the intervention components, and the delivery mode (Goode et al., 2015; Kim & Park, 2015; Kohl et al., 2013; Kuijpers et al., 2013; McAlpine et al., 2014; van den Berg, Peters, Kraaijeveld, Gielissen, & Prins, 2013). Generally, typical web-based interventions are modular in setup, are updated weekly, require weekly visits, last for about 10 weeks, and include interaction with the system, peers, or a counselor (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012). The actual use of most interventions was low or data on the use has been poorly reported (Kelders et al., 2012; Kohl et al., 2013). The extent of use might be influenced by differences in participant and intervention characteristics (Ritterband, Thorndike, Cox, Kovatchev, & Gonder-Frederick, 2009). Prior studies among cancer survivors have shown that different user characteristics were related to different user patterns: e.g., a higher usage was found among those with low levels of self-reported social support and a high illness burden, and among survivors who were working and who received radiotherapy (Berry, Blonquist, Patel, Halpenny, & McReynolds, 2015; Borosund, Cvancarova, Ekstedt, Moore, & Ruland, 2013). Being female, middle aged or older, having mid to high levels of education,

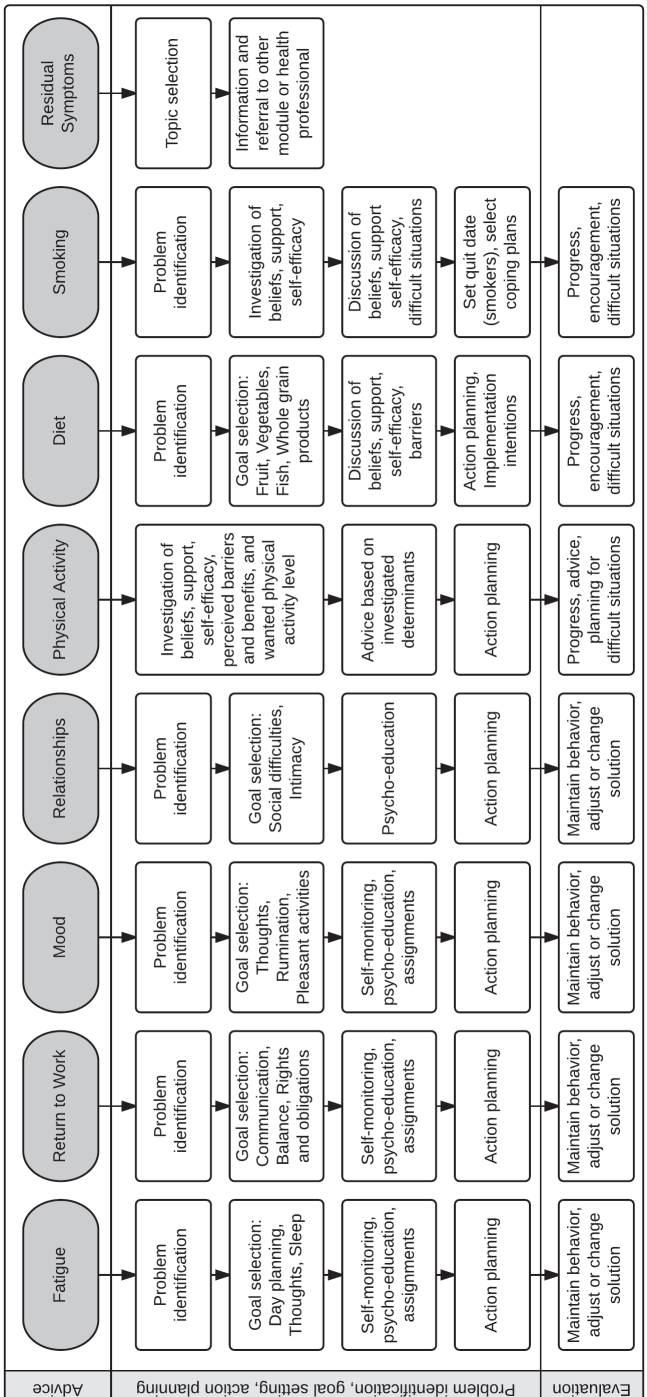

Figure 4.1 Overview of the scope and sequence of the modules. From Willemset al. (2015). ©2015 Willemset al. Reprinted with permission

a healthy body mass index (BMI), a healthier lifestyle, and having a low QoL were predictors for a higher use of (multiple behavior) eHealth interventions among the general population (Brouwer et al., 2010; Reinwand, Schulz, Crutzen, Kremers, & de Vries, 2015b).

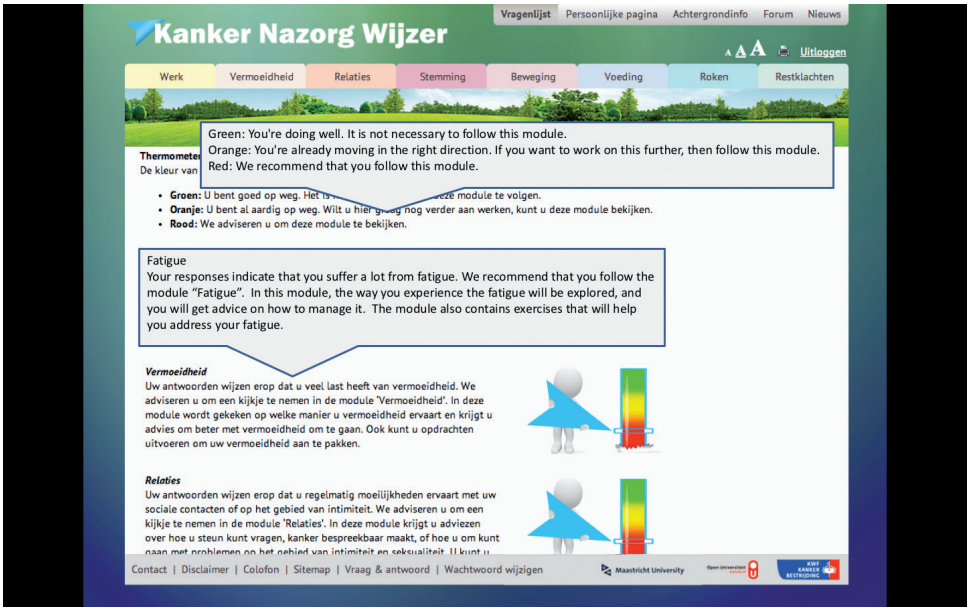

Figure 4.2 Module Referral Advice (MRA) that encourage participants to follow relevant KNW modules. Adapted from Willems et al. (2015); © 2015 Willems et al. Reprinted with permission

Reported intervention characteristics that might predict usage were peer or counselor support, in-person contact, updates of the intervention, and sending reminders (Brouwer et al., 2011; Kelders et al., 2012; Ritterband et al., 2009). According to previously published studies, mixed results were found on the relationship between intervention usage and outcomes, such as symptom distress, depression, and lifestyle behaviors (Berry et al., 2015; Donkin et al., 2013; Schulz et al., 2012). With regard to appreciation, prior studies reported that web-based interventions were positively evaluated by cancer survivors, and a higher use was associated with a higher appreciation in a generic web-based intervention for breast cancer survivors (De Cocker et al., 2015; Ritterband et al., 2012; van den Berg et al., 2013). The design of the KNW portal differs from most of the existing web-based interventions for cancer survivors by providing personalized self-management training on seven topics and by allowing users to choose which modules they want to use during an intervention period of six months. Previously identified effective intervention characteristics of web-based lifestyle interventions were tailored feedback, the use of theory, interactivity, goal setting, and online or in-person contact (Kelders et al., 2012; Kohl et al., 2013). The KNW

comprises all these elements, except for in-person contact. However, the MRA provides automated personalized guidance through the KNW modules. Given the large scope and the varied target group of the KNW portal, it is important to assess how the intervention was used, appreciated, whether the content was sufficiently tailored to be perceived as personal relevant, and what possible factors, including personal relevance, might predict the module use and its appreciation. In addition, the MRA might be a meaningful intervention component and therefore, the association between the MRA and the KNW module use also needs to be evaluated.

The main objective of the present study is threefold: 1) to describe the use of the KNW modules and to identify predictors of a higher number of modules used, 2) to investigate the adherence to the provided MRA, and 3) to describe the appreciation of the KNW and its predictors. Additionally, to explore how well the tailoring worked and whether the perceived personal relevance might be different among subgroups, we explored possible predictors of personal relevance.

METHODS

This process evaluation was conducted as part of a two-armed randomized controlled trial (RCT) that evaluates the effects of the KNW portal. For the purpose of the present report, all respondents of the intervention condition were included in the analyses. The details of the trial design, sample size calculation, participant eligibility, recruitment procedures, and the intervention have been published elsewhere (Kanera et al., 2016b; Willems et al., 2015, 2017a). Ethical approval for this trial (Dutch Trial Register NTR3375) was obtained from the Medical Research Ethics Committee, METC Z (NL41445.096.12, 12-T-115). All procedures performed in this study were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments of comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Specific intervention elements: Module Referral Advice and module principles

A comprehensive description of the intervention, including the eight KNW modules, the underlying theoretical frameworks, and technical features are published in detail elsewhere (Kanera et al., 2016b; Willems et al., 2015). This section describes the details of the MRA that was based on personal scores from the baseline questionnaire and that can refer to the seven self-management modules of the KNW (Figure 4.2). The classification criteria for "green", "orange", and "red" MRA are summarized in Table 4.1 (van den Brink, 2005; de Hollander, Zwart, de Vries, & Wendel-Vos, 2012; Hodgkinson et al., 2007b; Mesters et al., 2015; Mudde et al., 2006; van Sonderen, 2012; Vercoulen et al., 1994; Watson & Homewood,

2008; Wendel-Vos et al., 2003; Zigmond & Snaith, 1983). A green MRA signifies that the respondent reported no complaints, or minor complaints or needs, concerning the specific topic. Therefore, following the correspondent module is not a high priority. An orange MRA was provided when the respondents reported elevated but not severe complaints, or when respondents partially adhered to the lifestyle recommendations of the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) and the American Cancer Society (World Cancer Research Fund, 2009; Rock et al., 2012). The orange advice praises respondents' reasonably positive scores; however, it is recommended that they follow the corresponding module for further improvement. This orange category includes a wide coverage of score ranges, allowing for participants with higher, but not severe scores to still receive some positive and encouraging feedback and not lose their motivation to follow a module due to feedback that might be perceived as too stringent. A red MRA was provided only when severe psychosocial complaints, problematic functioning, or low/no adherence to lifestyle recommendations was reported, thus indicating that the respondent might be in high need of support concerning the specific topic. In that case, it was strongly recommended to follow the corresponding module. More detailed information on the underlying measures and cut-off points are described in Appendix 4.1.

Throughout the different KNW intervention modules, principles of Problem Solving Therapy, Cognitive Behavioral Therapy, social cognitive theories, and self-regulation theories were applied (Baumeister, Heatherton, & Tice, 1994; Bleijenberg et al., 2007; D'Zurilla & Nezu, 2007; de Vries et al., 2003). According to the I-Change Model (de Vries et al., 2003), awareness factors such as knowledge, cues to action, and risk perception might be important determinants in the dynamic process of behavior change by influencing motivation and intention. By applying the MRA, participants were made aware of their current psychosocial status and lifestyle behaviors in relation to the norms and guidelines, with the aim of guiding the participants toward the appropriate self-management modules. When using the modules, self-management skills training was provided by encouraging respondents to observe their current behavior more in detail, choose themes to work on, set goals, and to prepare action and coping plans, followed by monitoring their experiences and possible progress in the changed strategies and behaviors. Within the modules, the information and support was tailored to the current emotional status, lifestyle behavior, and motivational determinants (attitude, self-efficacy, intention) by the application of computer tailoring. Furthermore, the feedback was tailored to personal characteristics (gender, age, marital status, children, education level), and cancer-related and medical issues (type of cancer, comorbidities). Four weeks after completing (parts of) one module, the participants were invited to reflect upon their behavioral change plans and experiences in a brief personalized evaluation session. They were also encouraged to continue applying the previously recommended self-management skills. Furthermore, valuable generic information about lifestyle and psychosocial issues was accessible when visiting the user forum and the monthly news items.

Table 4.1 Classification of the green, orange and red MRA

	Measurements and classification criteria	MRA categories		
		Green	Orange	Red
Fatigue	CIS, subscale subjective fatigue (1-56)	< 27	27-35	> 35
Return to work	Extended CaSUN: Needs to adjust / find a job (0-5) Needs to receive financial support (0-5) Needs support on returning to work (0-5) Needs legal information (0-5)	No needs	Score on needs 3-12	Score on needs ≥ 13
Mood	HADS-A (0-21) HADS-D (0-21) MAC: dimension negative adjustment to cancer (16-64)	HADS-A < 8 and HADS-D < 8 and MAC ≤ 36	HADS-A < 8 and HADS-D 8-15; HADS-A 8-15 and HADS-D <8 or 8-15; and/ or MAC > 36	HADS-A < 8 or 8-15 and HADS-D >15; HADS-D < 8 or 8-15 and HADS-A >15
Relation ships	SSL-D (6-24) / CaSUN (2 items[1])	SSL-D ≤ 7	SSL-D = 8 or 9 & needs CaSUN	SSL-D ≥ 10 & needs CaSUN
Physical activity	SQUASH: Weekly **≥**150 min moderate to vigorous PA. Daily ≥30 mins of moderate PA on **≥** 5 days p/w	Meeting both conditions	Meeting one out of two conditions	Meeting no conditions
Diet	Dutch Standard Questionnaire on Food Consumption: Daily ≥200g vegetables Daily ≥2 pieces of fruit Weekly ≥2 servings of fish Daily ≥15g whole grains[2] Daily ≥ four servings of potatoes/ whole-grain rice/ whole-grain pasta	Meeting at least four out of five conditions	Meeting two or three out of five conditions	Meeting one or none out of five conditions
Smoking	Smoking, not smoking, time point of quitting	Never/former smokers, quit prior to cancer diagnosis	Quit smoking after cancer diagnosis	Current smokers

Note: CIS: Checklist Individual Strength; PA: physical activity, p/w: per week; HADS: Hospital Anxiety and Depression Scale, HADS-A: subscale anxiety, HADS-D: subscale depression; MAC: Mental Adjustment to Cancer Scale; SSL-D: Social Support List-discrepancy subscale; SQUASH: Short Questionnaire to Assess Health Enhancing Physical Activity; PA: Physical Activity

[1]Needs related to sexuality and fertility

[2]Whole-grain bread, oatmeal, cereals

Measurements

All data were derived from online self-report questionnaires and logging details.

Module use

Module use was assessed by using logging data. Actual use was dichotomized (*yes, no*) for each module separately (in total eight modules). Module use was categorized into *yes* when at least the first three pages of a module were used. These three pages comprised important key information after which participants followed personalized pathways through the modules. The individual pathways were based on the responses to the baseline questionnaire, own preferences and goals, and take into consideration that the amount of needed information and support can vary to initiate behavior change (Donkin et al., 2013). Additionally, by assessing login data (last day the separate modules were used), the number of weeks of module engagement was registered.

Appreciation

At six-month follow-up, the overall rating of the KNW and separate ratings for each of the used module(s) were assessed on a scale ranging from 1 (*very poor*) to 10 (*outstanding*) (e.g., "Overall, how do you rate the KNW? Select your rating (1-10)"; "How do you rate module Mood on a scale from 1 to 10"). Further, four separate items were measured to evaluate whether the provided information and support was understandable, useful, personally relevant, and recommendable to fellow patients, on a 5-point-Likert-scale, ranging from 1 (*low*) to 5 (*high*). The perceived personal relevance ("Was the information from the Kanker Nazorg Wijzer of personal relevance for you?") was included in the analysis of the present study to explore whether computer tailoring worked well within the KNW. These items correspond to items that were used in other studies to measure the appreciation of web-based interventions (Stanczyk et al., 2014; van Genugten et al., 2012; Walthouwer et al., 2015b).

Demographic and cancer-related variables

Information about demographic and cancer-related characteristics was collected at baseline. Standard questions were used to measure age, gender, marital status. Marital status was dichotomized into *with partner* (married, cohabiting partners) and *without partner* (single, divorced, widowed). Education level was categorized into *low* (lower vocational education, medium general secondary education), *medium* (secondary vocational education, higher general secondary education), and *high* (higher vocational education, university education). Employment status was dichotomized into *working* (self-employed, in paid employment) and *not working* (unemployed, retired, unable to work). Type of cancer was categorized

into *breast, colorectal*, and *other types of cancer* (i.e., bladder, esophageal, gynecologic, hematologic, kidney, liver, lung, prostate, stomach, testicular, and thyroid cancer). Type of treatment was categorized into *surgery and chemotherapy and radiotherapy*, *surgery and chemotherapy*, *surgery and radiotherapy*, and *other types of treatment*. Further, aftercare (*yes, no*) and comorbidities (*yes, no*) were measured, and height and weight were assessed to determine body mass index (BMI). The time since completion of primary treatment in weeks was based on registry data from the hospitals.

Statistical analyses

The analyses were performed using STATA version 13.1. Descriptive statistics were used to describe demographic and cancer-related characteristics of the module (non-) users and the number of weeks of module engagement among all participants of the intervention condition at baseline. To calculate the appreciation outcomes, participants who completed the relevant questions at the six-month measurement and who used the corresponding modules were included. Chi-square tests were used to determine the relationships between the MRA and the subsequent module use with a two-sided alpha = .05 level of significance. Negative binominal regression analysis was used to identify the predictors of a higher number of modules used (0-8), due to over-dispersed count data. Independent variables (hypothesized predictors) were demographic variables (gender, age, marital status, education, employment), cancer-related variables (cancer type, type of treatment, number of weeks after completing primary cancer treatment, aftercare, comorbidities, BMI), the number of red and orange MRA, ranging from 0-7, and the perceived personal relevance, ranging from 1-5. To examine the predictors of a higher overall appreciation of the KNW, multiple linear regression analysis was applied among participants who completed the follow-up questionnaire after six months. The dependent variable was the overall rating of the KNW, measured at six-month follow-up, ranging from 1-10. The same independent variables as described above were counted as predictors. Furthermore, the number of used modules (sum score 0-8) was added to the multiple linear regression model. To explore possible predictors of perceived personal relevance, ordered logistic regression analysis was conducted, taken into consideration that the dependent variable, perceived personal relevance, was an ordinal variable, ranging from 1-5. Within this analysis, all demographic and cancer-related characteristics were added as independent variables. Dummy coding was used for categorical variables including more than two categories and the continuous and ordinal variables were standardized in all conducted regression analyses. Since filling out all computer-based questions was required, and respondents were reminded automatically if a question was not answered, there were no missing data at baseline. Missing data at six-month follow-up that were due to dropout were not imputed when calculating appreciation outcomes.

RESULTS

Baseline characteristics of the intervention participants are displayed in Table 4.2. The majority of the participants was female (79.2%), mean age was 55.6 (*SD* = 11.5) years, and 70.1% had been treated for breast cancer. A detailed overview of cancer diagnoses among the sample is shown in Appendix 4.2. Mean time since completing primary cancer treatment was 25.1 (*SD* = 13.5) weeks.

Module use

The majority (80-100%) of the module users continued after reading the first three compulsory pages of the different modules. The numbers and percentages of participants who used the separate modules are displayed in Table 4.2. Module Diet (58%) was used most often, and the module Smoking was used least often (10%). However, from the smokers at baseline (*n* = 27), 13 (48.2%) individuals used the module Smoking. Overall, the participants used on average 2.1 (*SD* = 1.6) KNW modules; 14.3% used no modules, 30.3% used one module, 18.2% used two modules, 21.2% used three modules, 8.7% used four modules, 3.9% used five modules, and 3.4% used six or more modules. Module engagement was highest during the first 16 weeks after getting KNW access: around 80% of the users used the modules within this period.

Provided Module Referral Advice

Table 4.3 displays how the red, orange, and green MRA ranged among the participants and how the modules were used. For fatigue, diet and smoking more red compared to orange MRA was provided, and for return to work, mood, relationships, and PA, more orange compared to red MRA was given. Green MRA was most frequently given with regard to smoking, return to work, mood, and relationships. Module use after getting a red or orange MRA was 58.8% and 38.6% for module Fatigue, 55.6% and 52.4% for module Return to work, 25% and 30.3% for module Mood, and 25.9% and 27.3% for module Relationships. Concerning the lifestyle modules, module use after receiving a red or orange MRA for PA was 25% and 35%, for diet 50.4% and 68.7%, and for smoking 48.2% and 42.9%. From the 231 participants, 173 (74.9%) received at least one red MRA, and 192 (83.1%) received at least one orange MRA. On average, the participants were referred to 2.9 (*SD* = 1.5) relevant modules (either red or orange MRA, not displayed).

Table 4.2 Overall baseline characteristics of the KNW participants and categorized for module-use (*N* = 231)

			Modules of the Kanker Nazorg Wijzer							
	Overall	No module	Fatigue	Return to work	Mood	Relation ships	Physical Activity	Diet	Smoking	Residual Symptoms
	N = 231	*n* = 33 14.3%	*n* = 82 35.5%	*n* = 53 22.9%	*n* = 49 21.2%	*n* = 38 16.5%	*n* = 51 22.1%	*n* = 134 58%	*n* = 23 10%	*n* = 47 20.4%
Female, *n* (%)	183 (79.2)	26 (78.8)	63 (76.8)	46 (86.8)	41 (83.7)	30 (79.0)	44 (86.3)	106 (79.1)	17 (73.9)	40 (85.1)
Age, *M* (*SD*)	55.6 (11.5)	52.5 (10.7)	55.1 (11.6)	52.8 (9.5)	54.4 (11.7)	55.9 (12.1)	56.3 (9.7)	56.0 (11.1)	51.6 (8.7)	56.2 (9.0)
With partner, *n* (%)	193 (83.6)	27 (81.8)	65 (79.3)	43 (81.1)	37 (75.5)	31 (81.6)	42 (82.4)	109 (81.3)	16 (69.6)	36 (76.6)
BMI, *M* (*SD*)	26.0 (5.0)	27.2 (7.3)	26.2 (4.3)	25.7 (5.0)	25.3 (4.0)	26.1 (3.5)	26.1 (3.6)	25.4 (4.7)	24.8 (3.1)	25.4 (3.9)
Education, *n* (%)										
Low	76 (32.9)	13 (39.4)	23 (28.1)	12 (22.6)	15 (30.6)	12 (31.6)	18 (35.3)	42 (31.3)	9 (39.1)	13 (27.7)
Medium	76 (32.9)	12 (36.4)	31 (37.8)	20 (37.7)	20 (40.8)	13 (34.2)	18 (35.3)	44 (32.8)	7 (30.4)	14 (29.8)
High	79 (34.2)	8 (24.2)	28 (34.2)	21 (39.6)	14 (28.6)	13 (34.2)	15 (29.4)	48 (35.8)	7 (30.4)	20 (42.6)
Working at baseline, *n* (%)	122 (52.8)	20 (60.6)	40 (48.8)	38 (71.7)	28 (57.1)	18 (47.4)	27 (52.9)	70 (52.2)	13 (56.5)	26 (55.3)
Type of cancer, *n* (%)										
Breast	162 (70.1)	24 (72.7)	55 (67.1)	40 (75.5)	36 (73.5)	27 (71.1)	41 (80.4)	94 (70.2)	18 (78.3)	32 (68.1)
Colon	29 (12.6)	4 (12.1)	10 (12.2)	4 (7.6)	6 (12.2)	5 (13.2)	2 (3.9)	19 (14.2)	3 (13.0)	9 (19.2)
Other	40 (17.3)	5 (15.2)	17 (20.7)	9 (16.9)	7 (14.3)	6 (15.8)	8 (15.7)	21 (15.7)	2 (8.7)	6 (12.8)
Had cancer before, *n* (%)	24 (10.4)	5 (15.2)	8 (9.8)	3 (5.7)	4 (8.2)	3 (7.9)	5 (9.8)	13 (9.7)	2 (8.7)	5 (10.6)
Treatment, *n* (%)										
Surgery, chemo, radio	86 (37.2)	11 (33.3)	37 (45.1)	20 (37.7)	20 (40.8)	18 (47.4)	22 (43.1)	53 (39.6)	11 (47.8)	22 (46.8)
Surgery, chemo	61 (26.4)	11 (33.3)	17 (20.7)	16 (30.2)	16 (32.7)	9 (23.7)	12 (23.5)	35 (26.1)	7 (30.4)	15 (31.9)
Surgery, radio	46 (19.9)	5 (15.2)	15 (18.3)	11 (20.8)	10 (20.4)	5 (13.2)	11 (21.6)	26 (19.4)	3 (13.0)	8 (17.1)
other	38 (16.5)	6 (18.2)	13 (15.9)	6 (11.3)	3 (6.1)	6 (15.8)	6 (11.8)	20 (14.9)	2 (8.7)	2 (4.3)
Weeks since completion treatment, *M* (*SD*)	25.1 (13.5)	27.1 (15.6)	24.1 (14.4)	22.3 (13.7)	25.3 (13.6)	26.5 (12.9)	23.7 (13.6)	25.0 (13.1)	22.1 (13.2)	25.4 (3.9)
Having comorbidities, *n* (%)	62 (26.8)	10 (30.3)	25 (30.5)	14 (26.4)	12 (24.5)	10 (26.3)	15 (29.4)	34 (25.4)	7 (30.4)	8 (17.0)
Using aftercare, *n* (%)	145 (62.8)	25 (75.8)	46 (56.1)	38 (71.7)	32 (65.3)	29 (76.3)	31 (60.8)	83 (61.9)	12 (52.2)	29 (61.7)

Table 4.3 Provided MRA and subsequent module use

Module	Red			Orange			Green		
	MRA	Followed module, %		MRA	Followed module, %		MRA	Followed module, %	
	%	yes	no	%	yes	no	%	yes	no
Fatigue	34.6	58.8	41.3	19.1	38.6	61.4	46.3	16.8	83.2
Return to work	3.9	55.6	44.4	18.2	52.4	47.6	77.9	14.4	85.6
Mood	1.7	25	75	28.6	30.3	69.7	69.7	17.4	82.6
Relation ships	11.7	25.9	74.1	19.1	27.3	72.7	69.3	11.8	88.1
Physical activity	5.2	25	75	35.9	37.4	62.7	58.9	12.5	87.5
Diet	53.3	50.4	49.6	42.9	68.7	31.3	3.9	44.4	55.6
Smoking	11.7	48.2	51.9	3.1	42.9	57.1	85.3	3.6	96.5

Note: Red: urgent advice to use module; Orange: advice to use module; Green: using module not necessary (but possible)

Adherence to the provided Module Referral Advice

The relations between the color of the MRA (respectively red, orange, green) and module use are shown in Table 4.4. In general, the likelihood that participants actually used a relevant module was higher when the MRA was red or orange compared to green. When comparing module use after receiving a red MRA versus an orange MRA for the modules Return to work, Mood, Relationships, PA, Smoking, the differences were small, meaning that both colors led to comparable module participation. Participants used module Fatigue (χ^2 = 4.599, p = .032, OR = 2.262) more often when a red MRA was provided compared to an orange MRA. Module Diet (χ^2 = 7.553, p = .006, OR = .463) was used more often when an orange MRA was provided compared to a red MRA.

Appreciation

From the 231 participants who had access to the KNW intervention, 182 responded to the questions concerning appreciation after six months. The overall appreciation of the KNW was high (M = 7.5, SD = 1.2; Table 4.5). In general, the overall KNW was rated more positively among module users compared to non-module users. Ratings of the separate modules ranged from 6.4 (satisfactory) for module Residual Symptoms to 8 (*good*) for module Smoking. Personal relevance ranged from 2.9 to 3.5 (*a little bit relevant to relevant*). The ratings for comprehensibility, usefulness, and recommendation to other cancer survivors were all positive and very uniform (displayed in Table 4.5).

Table 4.4 Relationship between the MRA and module use (chi-square tests, df = 1)

	Red compared to orange			Red compared to green			Orange compared to green		
Module	*χ2*	*p*	Odds ratio [95% CI]	*χ2*	*p*	Odds ratio [95% CI]	*χ2*	*p*	Odds ratio [95% CI]
Fatigue	4.599	**.032**	2.262 [.99; 5.16]	35.485	**.000**	7.042 [3.12; 14.69]	8.332	**.004**	3.113 [1.30; 7.37]
Return to work	.030	.863	1.136 [.21; 6.56]	10.565	**.001**	7.404 [1.46; 39.25]	28.920	**.000**	6.515 [2.92; 14.47]
Mood	.050	.822	.767 [.01; 10.27]	0.156	.693	1.583 [.03; 20.50]	4.680	**.031**	2.065 [1.00; 4.21]
Relationships	.016	.901	.933 [.26; 3.11]	3.810	.051	2.597 [.81; 7.49]	6.349	**.012**	2.783 [1.11; 6.73]
Physical Activity	.696	.404	.186 [.00; 1.48]	1.474	.225	2.333 [.37; 10.57]	18.60	**.000**	4.173 [2.02; 8.74]
Diet	7.553	**.006**	.463 [.26; .83]	0.119	.730	1.27 [.26; 6.71]	2.182	.140	2.742 [.54; 14.67]
Smoking	.063	.803	1.238 [.17; 10.06]	58.075	**.000**	25.204 [7.67; 85.09]	22.400	**.000**	20.357 [2.40; 141.94]

Table 4.5 Appreciation of KNW after six months

	Overall	No module	Fatigue	Return to work	Mood	Relationships	Physical Activity	Diet	Smoking	Residual Symptoms
Overall KNW (1-10), *M* (SD)	7.5 (1.2)	7.1 (2.0)	7.6 (1.1)	7.6 (1.1)	7.4 (1.0)	7.4 (1.0)	7.6 (1.1)	7.5 (1.0)	7.8 (1.2)	7.4 (1.1)
Modules (1-10)[1], *M* (SD)			7.3 (1.3)	7.0 (1.3)	7.5 (1.2)	7.2 (0.8)	7.7 (1.1)	7.6 (1.0)	8 (1.3)	6.4 (1.9)
Sub questions on content (1-5)[2], *M* (SD)										
Understandable?	4.3 (0.6)	4.1 (1.0)	4.4 (0.5)	4.4 (0.5)	4.3 (0.5)	4.5 (0.5)	4.4 (0.5)	4.4 (0.5)	4.3 (0.5)	4.4 (0.5)
Useful?	3.7 (0.8)	3.7 (1.1)	3.8 (0.8)	3.7 (0.8)	3.7 (0.8)	3.7 (0.8)	3.7 (0.7)	3.7 (0.8)	3.8 (0.9)	3.4 (0.9)
Personal relevant?	3.2 (0.9)	2.9 (1.2)	3.4 (0.8)	3.3 (0.7)	3.2 (0.9)	3.4 (0.9)	3.5 (0.7)	3.2 (0.8)	3.3 (0.9)	3.3 (0.9)
Recommendable to fellow survivors?	3.9 (1.0)	3.6 (1.1)	3.9 (1.0)	3.9 (1.0)	3.8 (1.0)	3.7 (1.0)	4 (1.0)	3.9 (1.0)	4.1 (0.9)	3.8 (1.0)

Note:

[1]no module *n* = 18, Fatigue *n* = 47, Return to work *n* = 27, Mood *n* = 13, Relationships *n* = 11, PA *n* = 28, Diet *n* = 77, Smoking *n* = 6, Residual Symptoms *n* = 14

[2]no module *n* = 18, Fatigue *n* = 67, Return to work *n* = 46, Mood *n* = 45, Relationships *n* = 34, PA *n* = 45, Diet *n* = 115, Smoking *n* = 18, Residual Symptoms *n* = 39

Predictors of a higher number of modules used

Using a higher number of modules was predicted by a higher number of red/orange MRA (β = .136, p = .009), and by a higher perceived personal relevance (β = .150, p = .014). Moreover, having a partner was significantly related with a lower number of modules used (β = -.256, p = .044; Appendix 4.3).

Predictors of a higher appreciation of the overall KNW

A higher appreciation with the overall KNW was significantly predicted by a higher perceived personal relevance (β = .623, p = .000; Appendix 4.4). None of the demographic and cancer-related variables, or the number of red/orange MRA, or number of modules used predicted a higher overall appreciation of the KNW intervention.

Predictors of a higher perceived personal relevance

None of the demographic and cancer-related characteristics significantly predicted the perceived personal relevance of the KNW content, indicating that the KNW content was rated comparably personal relevant among individuals with different demographic and cancer-reacted characteristics (Appendix 4.5).

DISCUSSION

The present process evaluation of the web-based KNW evaluated the automated guidance toward the KNW modules and subsequent module use, and the appreciation of this intervention. Despite the noncommittal nature of the KNW, more than 85% of the participants used one or more of the eight modules, and there was clear interest in all eight modules. This result confirms the need for wide-ranging support among early cancer survivors. Interestingly, automated referrals to specific modules were related to a higher number of modules used. Moreover, the complex KNW was highly appreciated and perceived as personal relevant by early cancer survivors.

The MRA aimed to guide the respondents toward the appropriate modules by giving feedback about current problem areas and needs. Cancer survivors themselves might not have noticed some of these needs and the MRA may have raised awareness about these topics. The importance of increasing awareness is theoretically grounded as described by Weinstein and Sandman (1992) in their Precaution Adoption Process Model. That model includes a sequence of five stages within behavior change: *unaware of the issue*, *aware of the issue but not personally engaged*, *engaged and deciding what to do*, *planning to act but not yet having acted*, and *acting*. Prior research confirmed that a considerable number of colorectal cancer survivors were unaware of healthy diet recommendations, and older cancer

survivors reported being less aware of the beneficial effects of a healthy lifestyle (Hawkins et al., 2015; Niu et al., 2015). In addition, research revealed that cancer survivors might be less aware of available psychosocial support and solutions to psychosocial problems, while, for example, addressing maladaptive illness perceptions and adopting a more adaptive self-management may lead to better health outcomes (Mehnert & Koch, 2008; Thong, Kaptein, Vissers, Vreugdenhil, & van de Poll-Franse, 2016). Consequently, curiosity about available self-management support needs to be encouraged (Kohl et al., 2013). In accordance with the I-Change Model, the MRA could increase knowledge about the current level of well-being, psychosocial conditions, and lifestyle behavior. Besides that, the MRA could elevate the risk perception, and may serve as a cue to action with regard to the relevant topics, given that the solutions to the problems are provided (relevant self-management module; de Vries et al., 2003). These awareness/solution triggers might positively influence the motivation and intention to perform desired behavior, which is in line with the findings of Walthouwer, Oenema, Candel, Lechner, and de Vries (2015a), who identified awareness as an important moderator in the relationship between psychosocial determinants and specific dietary behavior (eating in moderation) in the general population. Results in the present study illustrate, that these awareness/solution triggers are most likely to be followed when a red or orange MRA was provided. Thus, the MRA successfully referred those respondents with elevated as well as severe complaints and/or needs. In particular, highly fatigued respondents (red MRA) were more likely to use the module Fatigue compared to participants with less fatigue (orange MRA). Additionally, those participants who were already (partly) engaged in a healthy diet (orange MRA) were more likely to use the module Diet compared to participants with less engagement in a healthy diet (red MRA). The topic diet could be of general interest of the participants, while the topic fatigue might be most interesting for participants with specific complaints. Consequently, the MRA may be a meaningful intervention component to increase motivation, subsequent module use, and problem-solution, while MRA adherence might be related to the specific behavior. Using topic-specific KNW modules has shown to be beneficial in decreasing fatigue, depressive feelings, and in increasing moderate PA, fruit and fish consumption (Kanera et al., 2016b; Willems et al., 2017).

Within the KNW, participants were referred on average to 2.9 modules, while on average 2.1 modules were used. The appreciation rates were high and the presented results showed that a higher number of modules used did not contribute to a higher appreciation; however, a higher perceived personal relevance did contribute to a higher appreciation. This is in line with Wilson et al. (2015), reporting that a moderate number of recommendations in multiple behavior interventions might produce the highest level of change, while engagement with a higher number of recommendations might be too demanding. Within the KNW, respondents were allowed to make their own choices, despite the provided MRA.

Prior research confirms that the possibility to choose within multiple behavior interventions may prevent high attrition rates and could improve intervention outcomes (Brouwer et al., 2010; Kwak et al., 2010; Schulz et al., 2012). Possibly, offering wide ranging support in combination with personalized referral to relevant topics and the possibility to choose might prevent overload. Donkin et al. (2013) support this suggestion by reporting that a certain level of usage might be needed to obtain benefit from an online intervention for depression. However, after reaching a point of therapy saturation, little or no additional program gains might be expected. This is in line with a web-based study among cancer survivors and with another web-based obesity prevention study among the general population, which reported that more intervention use did not result in better intervention outcomes (Borosund et al., 2013; Walthouwer, Oenema, Lechner, & de Vries, 2015c). Using a higher number of modules may not be necessary for all users to benefit most from the KNW. To illustrate, the present results revealed that having no partner was related to the use of a higher number of modules, and participants who were in greater need of support (higher number of red/orange MRA) indeed used a higher number of modules. This is in line with the findings of Borosund et al. (2013) who reported that particularly cancer survivors with low levels of social support and a high illness burden used self-management components of a web-based illness management support system. Furthermore, higher perceived personal relevance was related to using a higher number of modules, which might be explained by receiving a higher amount of computer tailored content within the modules. The overall KNW was highly appreciated with an average grade of 7.5, indicating an appreciation from very satisfactory to good. The low variability (*SD* = 1.2) indicates a considerably unanimous positive rating six months after getting access to the KNW. Results from the present study indicate that perceived personal relevance might be a key component to explain a higher appreciation. Computer tailoring was applied within the KNW in order to create personal relevant feedback. Since perceived personal relevance could not be predicted by demographic and cancer-related characteristics, we can conclude that the tailoring of information worked well. In comparison, the overall satisfaction of a generic fully automated web-based self-management intervention for breast cancer survivors was mean 7 (*SD* = 1.2; van den Berg et al., 2013). In addition, the overall appreciation of a web-based weight management intervention for overweight adults was mean 6.6, and the overall appreciation of a web-based text and video tailored intervention for smoking cessation in the general population was mean 6.5 (*SD* = 1.6; scales ranged from 1-10; Stanczyk et al., 2014; van Genugten et al., 2012). The overall appreciation ratings of KNW module users were more positive than the ratings of module non-users, although the module non-users were still quite positive in their ratings. In addition to the modules, the KNW comprises a user forum and participants received monthly emails inviting them to visit generic monthly news-items. Possibly, filling out the screening questionnaire and follow-up questionnaires,

combined with receiving personalized feedback on problem areas (by the MRA), and the additional KNW features, might already have raised awareness and provided other valuable information to achieve benefits among module non-users. Overall, the high appreciation rate indicates that the broad design and the tailored information of the KNW seem to fit well with the needs of early cancer survivors, in which, however, breast cancer survivors were overrepresented.

Limitations

Some limitations need to be addressed. First, providing data on completion of the separate themes and specific activities within the modules, and on completion of the evaluation sessions was not possible due to the module design. This information might be interesting for future studies, and therefore we recommend future interventions to study detailed participation of intervention modules in more depth than the current study. Second, within the present study, it was not possible to compare the relationships between the MRA and module use to a control group, which did not receive the MRA. Consequently, these associations need to be interpreted with caution, as it is conceivable that without the MRA, some of the same modules would have been used. Future experimental research might explore the specific effects of a similar automated referral system on subsequent choices. Third, this eHealth intervention requires respondents to have computer skills and health literacy, such as competences to access, understand, appraise, and applying the health information provided (Sørensen et al., 2012). However, since eHealth literacy was not assessed in this study, it is not possible to estimate the extent to which this might have influenced initial recruitment, and the use and appreciation of the KNW. Fourth, mainly middle-aged, female breast cancer survivors who scored fairly well on QoL and depression participated in the present study, which might be a too selective group to represent the general cancer survivor population. During recruitment, mainly breast cancer outpatient clinics participated, and besides that, five-year survival rates of breast cancer is relatively high (The Netherlands Cancer Registry, 2017). Unless mostly females with higher socioeconomic status are reached in web-based interventions in general, interpretations of the present findings should be viewed with caution (Kohl et al., 2013).

CONCLUSIONS

The general KNW and the KNW modules were substantially used and highly appreciated by early cancer survivors, thus confirming the need for wide-ranging support among this target group. Results indicate that the MRA may be seen as a meaningful key component of the fully automated KNW intervention by guiding users to follow a preferred selection of modules, given their current complaints and identified needs. Moreover, the overall

intervention and the separate modules were highly appreciated which could be explained by a higher perceived personal relevance. We can conclude that computer tailoring worked well, and that the range of topics, design, and personalized information suited the needs of early cancer survivors. This process evaluation adds meaningful information on the use and appreciation of web-based cancer aftercare interventions, and confirms that the KNW comprises valuable and appropriate support for early cancer survivors that can complement usual cancer aftercare and may serve as a first step in a stepped-care approach.

APPENDIX 4.1

Determination of the Module Referral Advice-categories (red, orange, green)

Return to work

The Module Referral Advice (MRA) concerning *return to work* was based on four items from the extended Cancer Survivors' Unmet Needs questionnaire (CaSUN; Hodgkinson et al., 2007b; Mesters et al., 2015; Willems et al., 2016) that were formulated as follows: 1) "I need help to make adjustments to my job or to find a new job", 2) "I need help to find out details about receiving financial support", 3) "I need help with carrying out my work", 4) "I need information about rules and legislation on returning to work". Respondents indicated whether they have no need, a met need, or an unmet need. Strength of unmet needs is rated as weak, moderate, or strong. The item range was 0-5, with a total score range of 0-20. Scores ranging from 0-3 (*no actual need*) were classified into a green MRA, scores ranging from 3-12 (*some needs*) into an orange MRA, and scores higher than 12 (*strong needs*) were classified into a red MRA.

Fatigue

The *fatigue* MRA was based on eight items of the subscale subjective fatigue of the Checklist Individual Strength (CIS; e.g., "I am feeling tired") with an item range of 1-7 (score range of 8-56; Vercoulen et al., 1994). The classification into a green, orange, and red MRA corresponded to the cut-off scores of the CIS subscale subjective fatigue: < 27 = *normal* (green), 27-35 = *elevated* (orange), > 35 = *severe*.

Social Relationships

For the MRA classification of *social relationship* issues, the discrepancy subscale from the 6-item version of the Social Support List (SSL-D) was used (van Sonderen, 2012). The items ranged from 1-4 with a total score range of 6-24 and measures the extent to which the respondent is experiencing a lack of social support. Green, orange, and red categories were constructed by combining the SSL-D with two items from the extended CaSUN. Scores of SSL-D ≤ 7 ("social support is just right") resulted in a green MRA, scores of 8 and 9 on the SSL-D (experiencing two or three problems with social support) in combination with one of the needs concerning fertility or sexuality resulted in an orange MRA, and scores of 10 or higher on the SSL-D (experiencing at least four problems with social support) resulted in a red MRA.

Mood

The MRA with regard to *mood* was based on responses to the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) and the dimension *negative adjustment*

of the Mental Adjustment to Cancer Scale (MAC; Watson & Homewood, 2008). Concerning the HADS, seven items for anxiety and seven items for depression were measured on a 4-point scale with scores ranging from 0-21. Negative mental adjustment comprises 16 items of the MAC as described by Watson et al. (2008) with scores ranging from 16-64, and a cut-off score of 36 indicating problematic functioning. Scores lower than 8 on the subscale anxiety and the subscale depression on the HADS, and a MAC score of 36 or lower resulted in a green MRA, indicating no/low psychological distress and no/low problematic functioning. A MAC score higher than 36 in combination with a score of 8-15 on one of the HADS subscales was categorized into an orange MRA. When the scores on one of the HADS subscales were higher than 15, or when both subscale scores were higher than 15, a red MRA was provided.

Physical Activity and Diet

The MRA for *physical activity (PA)* and *diet* was constructed according to the lifestyle recommendations of the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) and the American Cancer Society (World Cancer Research Fund, 2009; Rock et al., 2012). The classification criteria are displayed in Table 4.1. PA was assessed by applying the validated 11-item self-report Short Questionnaire to Assess Health Enhancing PA (SQUASH; de Hollander et al., 2012; Wendel-Vos et al., 2003). The number of days a week of PA (≥ 30 minutes of moderate intensity), the average number of minutes per day, and the intensity (light, moderate, vigorous) were rated for activities during commuting, work, household, leisure time, and sports (Kanera et al., 2016b).

Dietary behavior was measured by using eight items from the Dutch Standard Questionnaire on Food Consumption to assess vegetable, fruit, fish, whole-grain bread, oatmeal, cereal, potato, whole-grain rice, and whole-grain pasta consumption (van den Brink et al., 2005; Kanera et al., 2016b). A green MRA was provided when respondents met four out of five dietary recommendations as displayed in Table 4.1. When reporting that two or three out of five conditions were met an orange MRA was provided, and respondents who met one or none of the five conditions received a red MRA.

Smoking

The *smoking* MRA was based on current and former smoking behavior, which was measured by using three standardized questions from the Dutch Measuring Instruments for Research on Smoking and Smoking Cessation (Kanera et al., 2016b; Mudde et al., 2006). Respondents who had never smoked before and former smokers who quit smoking prior to the cancer diagnosis received a green MRA, former smokers who quit when the cancer was diagnosed received an orange MRA, and current smokers received a red MRA.

APPENDIX 4.2

Overview of cancer diagnoses among the KNW sample, *N* = 231

Type of cancer	*N*	%
Breast	162	70.13
Colon	29	12.55
Non-Hodgkin lymphoma	10	4.33
Lung	5	2.16
Uterus	4	1.73
Prostate	3	1.30
Esophagus	3	1.30
Kidney	3	1.30
Ovary	2	0.87
Vulva	2	0.87
Testicle	2	0.87
Cervix	1	0.43
Thyroid	1	0.43
Stomach	1	0.43
Bladder	1	0.43
Hodgkin lymphoma	1	0.43
Multiple Myeloma	1	0.43

APPENDIX 4.3

Predictors of a higher number of modules used, *N* = 182

	Higher number of followed modules (0-8)		
Variable	**Beta**	***SE* [95% CI]**	***p***
Female gender	.068	.235 [-.39; .53]	.771
Age	.030	.066 [-.10; .16]	.650
Marital status: with partner	-.256	.127 [-.50; -.01]	**.044**
Being employed: *yes*	.177	.102 [-.08; .41]	.192
Education level (low = ref)			
Medium	.135	.123 [-.11; .38]	.274
High	.165	.127 [-.08; .41]	.192
Breast cancer (other = ref)	.035	.212 [-.38; .45]	.867
Primary cancer treatment (other = ref)			
Surgery & radiation	.147	.181 [-.31; .40]	.797
Surgery & chemo	.273	.183 [-.09; .63]	.163
Surgery & chemo & radiation	.251	.168 [-.08; .58]	.135
Number of weeks after completing treatment	.016	.048 [-.08; .11]	.730
Participating in aftercare: *yes*	-.076	.108 [-.29; .14]	.481
Having co-morbidities: *yes*	-.054	.122 [-.29; .19]	.657
BMI	-.058	.057 [-.17; .05]	.311
Number of orange/red MRA (0-7)	.136	.053 [.03; .24]	**.009**
Perceived personal relevance (1-5)	.150	.061 [.03; .27]	**.014**
Constant	.664	.316 [.04; 1.28]	.036
Pseudo R^2	.051		
Wald χ^2 (15)	51.48		.000

Note: Negative binomial regression was used. Beta = regression coefficient.
Abbreviations: ref: reference group; BMI: Body Mass Index; MRA: module referral advice

APPENDIX 4.4

Predictors of a higher appreciation of the overall KNW, *N* = 182

	Appreciation (1-10)		
Variable	**Beta**	***SE* [95% CI]**	***p***
Female gender	-.223	.355 [-.92; .48]	.530
Age	.069	.117 [-.16; .30]	.557
Marital status: with partner	.359	.265 [-.17; .88]	.178
Being employed: *yes*	.123	.178 [-.25; .49]	.514
Education level (low = ref)			
Medium	-.074	.198 [-.47; .32]	.708
High	.160	.181 [-.20; .52]	.379
Breast cancer (other = ref)	.242	.347 [-.44; .93]	.488
Primary cancer treatment (other = ref)			
Surgery & radiation	-.005	.344 [-.68; .67]	.987
Surgery & chemo	.011	.272 [-.55; .53]	.967
Surgery & chemo & radiation	-.409	.284 [-.97; .15]	.152
Number of weeks after completing treatment	.016	.077 [-.14; .17]	.833
Participating in aftercare: *yes*	-.166	.196 [-.55; .22]	.397
Having co-morbidities: *yes*	.359	.182 [-.00; .72]	.051
BMI	-.013	.018 [-.05; .02]	.474
Number of orange/red MRA (0-7)	-.158	.102 [-.36; .04]	.122
Number of followed modules (0-8)	.027	.080 [-.13; .18]	.738
Perceived personal relevance (1-5)	.623	.097 [.43; .82]	**.000**
R^2	.361		
F	1.013		.000

Note: Multiple linear regression was used. Beta = regression coefficient.
Abbreviations: ref: reference group; BMI: Body Mass Index; MRA: Module Referral Advice

APPENDIX 4.5

Predictors of a higher perceived personal relevance of the KNW content, *N* = 182

	Perceived personal relevance (1-5)		
Variable	**Beta**	***SE* [95% CI]**	***p***
Female gender	-.027	.614 [-1.23; 1.18]	.964
Age	-.123	.221 [-.56; .31]	.578
Marital status: with partner	.246	.340 [-.54; 1.03]	.538
Being employed: *yes*	-.248	.342 [-.92; .42]	.468
Education level (low = ref)			
Medium	-.597	.369 [-1.32; .13]	.106
High	-.698	.368 [-1.42; .02]	.058
Breast cancer (other = ref)	-.403	.581 [-1.54; .74]	.488
Primary cancer treatment (other = ref)			
Surgery & radiation	-.303	.542 [-1.37; .76]	.576
Surgery & chemo	.600	.464 [-.31; 1.51]	.196
Surgery & chemo & radiation	.027	.479 [-.91; .97]	.955
Number of weeks after completing treatment	-.108	.140 [-.38; .17]	.439
Participating in aftercare: *yes*	.188	.332 [-.46; .84]	.570
Having co-morbidities: *yes*	-.054	.328 [-.70; .59]	.868
BMI	.013	.149 [-.28; .30]	.933
Pseudo R^2	.031		
χ^2	14.58		.407

Note: Ordered logistic regression was used. Beta = regression coefficient.
Abbreviations: ref: reference group; BMI: Body Mass Index; MRA: Module Referral Advice

PART III

Intervention effect evaluation

Lifestyle-related effects of the web-based *Kanker Nazorg Wijzer* (Cancer Aftercare Guide) intervention for cancer survivors. A randomized controlled trial

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ABSTRACT

Purpose

The web-based Kanker Nazorg Wijzer (Cancer Aftercare Guide) responds to the needs of cancer survivors and oncology care providers to improve the counseling related to self-management of lifestyle and psychosocial challenges. In present study, overall intervention effects, and the effects of using specific intervention components were evaluated on vegetable, fruit, whole grain bread, and fish consumption, physical activity, and smoking behavior.

Methods

Cancer survivors from 21 Dutch hospitals were recruited for a randomized controlled trial (N = 462). Intervention effects after six months were evaluated using multilevel linear regression analysis (complete cases and intention-to-treat). By conducting moderation analyses, additional effects of using the behavior-related modules were explored. The false discovery rate correction was applied to account for multiple testing.

Results

After six months, 409 participants completed follow up (dropout = 11.5%). Indications were found that access to the intervention may result in increases of moderate physical activity and vegetable intake. The moderate physical activity increase was meaningful: 74.74 minutes per week higher increase in the intervention condition. Effect sizes of moderate physical activity (d = .25), and vegetable (d = .37) consumption were comparable to prior effective interventions. Visiting behavior-related modules affected moderate physical activity, fruit, and fish consumption. However, after correction for multiple testing, significances expired. No significant intervention effect was found on smoking behavior due to low numbers of smokers.

Conclusions

Although the effectiveness was shown to a limited extend, this study provided several indications that this theory-based, comprehensive and personalized eHealth intervention provides valuable content to complement usual cancer aftercare.

BACKGROUND

Healthy lifestyle behaviors have been proven to be highly beneficial for cancer survivors in improving recovery and quality of life (QoL) and lowering the risk of cancer recurrence and comorbidities (Baena & Salinas, 2014, 2015; Florou et al., 2014; Husson et al., 2015; Schmid & Leitzmann, 2014; Vijayvergia & Denlinger, 2015). As a result, comprehensive lifestyle recommendations have been developed by the World Cancer Research Fund (2009) and the American Institute for Cancer Research (WCRF/AICR) and the American Cancer Society (Kushi et al., 2012; Rock et al., 2012). The recommendations with regard to physical activity (PA) and dietary behavior are displayed in Box 5.1. In addition, it is advised to refrain from smoking (Boyle et al., 2015; Florou et al., 2014; National Comprehensive Cancer Network, 2015; Vijayvergia & Denlinger, 2015). Nonetheless, and despite the beneficial effects, only about 30 – 47% of cancer survivors follow the PA recommendations, about 15 – 34% follow the vegetable and fruit recommendations, and about 7.8 - 20.8% continue to smoke (Blanchard et al., 2008; Inoue-Choi et al., 2013; Kanera et al., 2016a; LeMasters et al., 2014; Westmaas et al., 2014; Zhang, Liu, John, Must, & Demark-Wahnefried, 2015). In turn, cancer survivors have indicated unmet needs in psychosocial and physical domains, including the need for specific and evidenced based information and support to build up PA, to improve their diet, and to quit smoking. These needs have been stressed by oncology care providers as well (Anderson et al., 2013; Coa et al., 2015; James-Martin et al., 2014; Kwok et al., 2015; Pullar et al., 2012; Willems et al., 2016; Wu & Harden, 2015). Moreover, oncologists have expressed a lack of time and expertise as barriers to giving multiple lifestyle behavior advice (Coa et al., 2015; Demark-Wahnefried et al., 2015; Warren et al., 2013). Consequently, health promotion initiatives should respond to these needs, and to the problems of care professionals who are serving a growing number of cancer survivors with restricted time, knowledge, and counseling skills (Azadmanjir, Safdari, & Ghazisaeidi, 2015; Comprehensive Cancer Centre the Netherlands, 2011b; De Angelis et al., 2014; Hammer et al., 2015).

An increasing number of cancer survivors search the Internet for health-related information (Chou et al., 2011; Warren et al., 2014). Web-based interventions have a wide reach and can be used at any time, any place and at an individuals' own pace. They might be also less costly than face-to-face interventions (Kohl et al., 2013). Additionally, web-delivered interventions can effectively provide personalized information by means of computer tailoring, a proven effective method in health behavior change interventions (Broekhuizen et al., 2012; Civljak, Stead, Hartmann-Boyce, Sheikh, & Car, 2013; Neville, O'Hara, & Milat, 2009; Peels, van Stralen, et al., 2014; Schulz et al., 2014; Te Poel et al., 2009; van Stralen et al., 2009).

Box 5.1 Lifestyle recommendations for cancer survivors used in the KNW intervention

Physical Activity recommendation
At least 150 minutes a week moderately intense activities, spread over at least 5 days a week (e.g., 30 minutes a day)
Healthy diet recommendation
At least 200 g vegetables every day
At least 200 g (2 pieces) of fruits every day
Whole grain bread[1]: 6-7 slices (men); 5-6 slices (women) every day
Fish two times per week
Limitation of alcohol to one consumption (women) / two consumptions (men) a day
Less than 500 g a week of red and processed meat
Less than 6 g a day of salt
Limitation of processed energy-dense foods

Note: Adapted from "Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective." by WCRF / AICR (2009) and "American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention. Reducing the Risk of Cancer With Healthy Food Choices and Physical Activity" by Kushi et al. (2012; not all recommendations are displayed)
[1] for persons aged 18-70 years.

We developed and evaluated a web-based, computer tailored intervention for cancer survivors, named *Kanker Nazorg Wijzer* (Cancer Aftercare Guide, KNW) which aims to complement existing face-to-face aftercare. The detailed research protocol has been described earlier by Willems et al. (2015). The comprehensive content of the KNW covers a combination of multiple lifestyle issues and psychosocial elements, provided through eight specific modules. The lifestyle components of this program, operationalized through the modules Physical Activity, Diet, and Smoking are based on assumptions of the Integrated Model for Change (I-Change Model; de Vries et al., 2003) in which ideas of social-cognitive theories are integrated (Ajzen, 2011; Fishbein & Ajzen, 2010). Furthermore, change methods derived from of the Self-regulation Theory (Baumeister et al., 1994) were applied. Previous research has demonstrated that interventions targeting cancer survivors' behavior change, such as PA and dieting are effective when these incorporate social-cognitive theories (Green et al., 2014; Stacey, James, Chapman, Courneya, & Lubans, 2015). The theoretical models explain behavior change as a dynamic process with a series of awareness, initiation, and maintenance phases that are influenced by pre-motivational (awareness and knowledge), motivational (intention, attitude, self-efficacy), and post-motivational determinants (goal setting, action- and coping planning; Bolman et al., 2015; de Vries et al., 2013; Peels, 2014). The theories assume that a continuous process of self-regulation is facilitated through the application of behavior change strategies such as goal setting, action- and coping planning, monitoring, evaluating plans, and refining goals when necessary (Bartholomew et al., 2011; Lechner, Mesters, & Bolman, 2010). In addition, the contribution of the determinants to change can differ from one behavior to another and from one person to another (Fishbein &

Ajzen, 2010; Kanera et al., 2016a). Consequently, behavior change interventions need to be tailored to the specific behavior, individual determinants, and motivational phases (Kanera et al., 2016a; Noar et al., 2007). During the development of the KNW, these aspects were taken into account by tailoring the provided information to relevant determinants.

Only few theory-based studies have been conducted which have investigated the effect of web-based interventions aimed at lifestyle outcomes in cancer survivors (Goode et al., 2015; Kuijpers et al., 2013). Increases in PA and mixed results in diet change have been reported in web-based interventions for cancer survivors using behavior change strategies such as action planning, problem solving, decision making, and tailoring (Bantum et al., 2014; Lee et al., 2014). Moreover, a usability study revealed that a web-based computer tailored intervention for breast cancer survivors based on the Theory of Planned Behavior and the Transtheoretical Model was well accepted and perceived as interesting, attractive, comprehensible and credible (De Cocker et al., 2015). Besides that, a web-based smoking cessation intervention among cancer survivors, based on social cognitive theories and tailored to stage of readiness, yielded equivalent levels of success compared to an intervention delivered by telephone (Emmons et al., 2013). Thus, current evidence is limited but promising concerning the effects of theory grounded, web-based, computer tailored interventions on (multiple) lifestyle behaviors for cancer survivors.

In the present study, we assessed the effects of the KNW on lifestyle outcomes (PA, diet, and smoking) six months after getting access to the intervention, among cancer survivors who recently completed primary cancer treatment. First, we assessed whether having access to the KNW may improve PA, diet behavior (fruit, vegetable, whole grain bread and fish consumption), and can lead to a higher rate of quitters among smokers in comparison to a usual care control group. Second, we explored the effects of following the module Diet on diet outcomes specifically, and the effects of following the module PA on PA outcomes.

METHODS

Trial design

A randomized controlled trial was conducted to reveal effects between participants assigned to the intervention condition (IC), or the usual care control condition (UC). Randomized allocation (ratio of 1:1) was automatically performed by means of a digital randomizer after centralized registration of participants (OverNite Sofware Europe). Ethical approval for this trial (Dutch Trial Register NTR3375) was obtained from the Medical Research Ethics Committee (MERC) Z (NL41445.096.12, 12-T-115). After approval, the MERC's and the board of directors of each hospital endorsed the execution of the study.

Participants

Dutch speaking individuals aged 18 years or older, who have been diagnosed with any type of cancer, and who have completed primary treatment (surgery, chemo- or radiation therapy) at least four weeks and up to 56 weeks prior to initial participation[1] with no sign of recurrence at the last control visit were eligible to be included in this study. Cancer survivors with severe medical, psychiatric, or cognitive disorders were excluded.

Procedure

Of the 45 Dutch hospitals approached, 22 hospitals agreed to participate. Medical staff from 21 hospitals recruited eligible participants from November 2013 through June 2014. Unfortunately, one hospital did not include any patients. Medical staff of various outpatient clinics (internal medicine, oncology, gynecology, urology, breast cancer care) assessed eligibility during the medical consultations or by reviewing patient files. Gender, age, type of cancer, type of treatment, and the termination date of primary cancer treatment were registered for all approached cancer survivors. Eligible cancer survivors received an information package, in person or by post, including comprehensive trial information, a general information brochure about scientific research (Ministerie van Volksgezondheid, 2014), an informed consent form, a short log-in instruction guide, a storage card with contact details and personal login codes to the KNW website. Consenting cancer survivors were asked to return the signed informed consent form to the researchers in an enclosed, pre-paid envelope. The participants received a reminder letter after two weeks. At the first login to the KNW, participants were automatically randomized to one of the two study conditions and the computer program directly provided information about their allocation. Data from participants who did not return the informed consent forms were excluded from analysis. After randomization, participants were invited to fill out the online self-report baseline questionnaire. Online follow-up measurements were conducted after three, six and 12 months. The IC received access to the KNW throughout the six months after completing the baseline assessment while the UC had access to the KNW after completing the 12 months measurement.

Intervention

A detailed description of the KNW intervention is reported elsewhere (Willems et al., 2015). The KNW (http:// www.kankernazorgwijzer.nl) is a systematically developed, theory-

1 After recruitment, it was observed that participants had been included slightly earlier or later than initially defined (6-52 weeks after completion of primary treatment; Willems et al., 2015). This inclusion criterion was broadened to enable analysis of data filled out four weeks ($N = 13$) and up to 56 weeks ($N = 7$) after completion of primary treatment. We assumed that cancer survivors, who voluntarily participated two weeks earlier and one month later than predetermined, were not different as compared to the other participants.

grounded, web-based intervention aiming to enhance QoL among early cancer survivors by promoting positive lifestyle changes (i.e., sufficient PA, healthy diet, and smoking cessation) and by providing psychosocial support in the area of fatigue, anxiety and depression, relational problems, and return to work. Each separate topic is integrated in one of the eight KNW modules.

After completing the baseline assessment, participants (IC) received personalized recommendations on which modules could be most meaningful for them. The recommendations were based on the responses to the baseline assessment (for detailed information see Willems et al., 2015). Nevertheless, the program allows the user to make a free selection of all modules based on personal needs and interest.

Technically, the KNW is a fully automated expert system containing an extensive pre-programmed message library that operates without human involvement. By means of computer tailoring, individual answers to the baseline assessment are automatically evaluated, and the corresponding messages and intervention fragments from the pre-programmed library are selected and combined, using if-then algorithms. Consequently, personalized information is generated (de Vries & Brug, 1999). The information within the KNW is tailored to personal characteristics (gender, age, marital status, children, educational level), cancer-related issues (type of cancer, type and number of comorbidities), motivational determinants (attitude, self-efficacy, social support, and intention), and current behavior (e.g., lifestyle).

Concerning the content of the KNW, seven out of the eight modules are self-management modules and configured to target the specific needs associated with the relevant topic. The eighth module provides general information about the most common residual problems.

The main target of the module PA was to increase PA, during, for example commutes, daily living activities, leisure time, and sports. In the module Diet, the emphasis is placed on increasing healthy eating behaviors through fruit, vegetable, whole grains, and fish consumption. The participants were encouraged to set one or two goals concerning these food groups. Promoting the consumption of healthy food might be a more positive way to achieve changes in diet than by focusing on omission of unhealthy food. More healthy food choices could lead to fewer unhealthy choices. High-fiber diets are, for example, commonly low in fat (Davies et al., 2011). However, all dietary recommendations, including the limitation of red meat, fat, sugar, salt, and alcohol consumption, were presented within the module Diet (Box 5.1). The goal of module Smoking was to support smokers in refraining from smoking. In addition, support was also provided to former smokers to prevent relapse.

Throughout the KNW, principles of Problem Solving Therapy have been applied to encourage self-management (D'Zurilla & Nezu, 2007). Within the lifestyle modules, motivational determinants were addressed based on social-cognitive theories, e.g., the I-Change Model, and self-regulation strategies were applied (Baumeister et al., 1994; de Vries et al., 2003;

Fishbein & Ajzen, 2010). Used behavior change strategies were consciousness-raising by pointing out the discrepancy between current behavior and recommendations; identifying pros and cons; identifying barriers and providing solutions; persuasive communication; self-monitoring; social modeling; goal setting; action and coping planning (Bolman et al., 2015; de Vries et al., 2013; Peels et al., 2014b; van Stralen et al., 2009). When visiting a lifestyle module, participants were made specifically aware of their own behavior in relation to the norms. Detailed and personalized feedback targeting attitudes, social support, self-efficacy, barriers, and intentions toward behavior change was provided. Text, photos, videos of fellow survivors and specialists, and hyperlinks to other sources of information were used for this purpose. In addition, the respondents were encouraged to set goals for PA and diet, and smokers were encouraged to set a smoking cessation date. Following this, detailed examples of action- and coping plans were provided to help prepare the behavior change (de Vries et al., 2013). After four weeks, participants were invited to evaluate their behavior and encouraged to continue applying the previously provided self-regulation strategies. Furthermore, use of the KNW forum was suggested for interaction with peer cancer survivors and social support.

To encourage the use of KNW, several e-mail-reminders and prompts were sent automatically with a direct link to the KNW, for example to invite participants to complete questionnaires or visit modules. Furthermore, additional information was provided by launching monthly news items linked to visiting the website. The KNW was applied without major adjustments, bugs or downtimes after the trial commencement. Hyperlinks to other websites were updated when needed.

Outcome measures

Physical activity

The validated self-report Short Questionnaire to Assess Health Enhancing Physical Activity (SQUASH) was applied at baseline and at the 6-month follow-up (de Hollander et al., 2012; Wendel-Vos et al., 2003; Wendel-Vos & Schuit, 2004). PA was determined based on 11 items including activities during commuting (walking, cycling), leisure time (walking, cycling, gardening, odd jobs), sports (light, moderate, vigorous), household tasks (light work, intense work), and work (light work, intense work). The number of days a week, the average number of minutes a day, and the intensity (light, moderate, vigorous) were rated for all activities. The average weekly minutes of PA were calculated by multiplying the number of days per week with the number of minutes per day, categorized into three categories: *light PA*, *moderate PA*, and *vigorous PA*. In the present study, the outcome measures for PA were *weekly days of > 30 min moderate to intensive PA*, *weekly minutes light PA*, *weekly minutes moderate PA*, and *weekly minutes vigorous PA*. One further item was included assessing the number of weekly days with at least the recommended amount of PA by asking: "On how

many days a week are you moderately physically active for at least 30 minutes (e.g., cycling, brisk walking, household, gardening, sports, or other activities)?" (van Stralen et al., 2009). Prior studies supported the reliability and validity of single-item self-report measures for PA (Milton, Bull, & Bauman, 2011; Milton, Clemes, & Bull, 2013). Moreover, reliability and validity of the SQUASH was confirmed in previous research among patient populations (Arends et al., 2013; Wagenmakers et al., 2008).

Dietary behavior

For assessing vegetable, fruit, whole grain bread and fish consumption, relevant items of the Dutch Standard Questionnaire on Food Consumption were used at baseline and after six months (van den Brink et al., 2005). The number of days per week when products are consumed were asked for each of the food categories (e.g., "How many days a week do you eat fruit?"), ranging from 0 - 7. In addition, the number of servings per day was assessed for fruit (one serving is equal to 100 g), vegetables (one tablespoon is equal to 50 g), whole grain bread (slices), and fish (servings). The mean daily consumption was calculated by multiplying the number of days by the amount of servings and dividing this by 7 days a week. For fish, servings per week were measured, and the mean weekly consumption was calculated. Outcome measures for dietary behavior in the present study were vegetable consumption in grams per day (g p/d), fruit consumption in servings p/d, whole grain bread consumption in slices p/d, and fish consumption in servings p/w. Previous research supports the reliability and validity of a similar food frequency questionnaire assessing vegetables en fruit among women (Bogers, Van Assema, Kester, Westerterp, & Dagnelie, 2004).

Smoking behavior

Standardized questions from Dutch Measuring Instruments for Research on Smoking and Smoking Cessation were used to assess smoking behavior (Mudde et al., 2006). Based on a combination of three items, current and former smoking behavior was measured at baseline (i.e., "Do you currently smoke"; "Did you smoke in the past?"; "How long ago did you stop smoking?"), and categorized into *never-smokers*, *former smokers* and *current smokers*. At follow-up, four items were used to assess smoking behavior. This behavior was categorized into *current smokers* ("I still smoke, and I did not attempt to quit), *never-smokers* ("I never smoked, I'm a non- smoker"), and *former smokers* ("I have not smoked a single puff since quitting"). It was also measured whether participants who smoked at baseline quit smoking by means of the standardized 7-day point prevalence abstinence question ("Have you smoked one or more cigarettes/cigars/pipes during the past seven days"; Hughes et al., 2003; Velicer & Prochaska, 2004). To identify the intervention effect after six months on smoking behavior (*yes* = 0, *no* = 1), only the subsample of participants who were smokers at baseline was analyzed.

Other relevant measures

Background information was collected at baseline using standard questions on age, gender, marital status (*with partner*: married, cohabiting partners; *without partner*: single, divorced, widowed), education level (*low*: lower vocational education, medium general secondary education; *medium*: secondary vocational education, higher general secondary education; *high*: higher vocational education, university education), income level (*below average*: < €1800 per month; *average*: > €1800 and < €2200 per month; *above average*: > €2200 per month), employment status (*working*: self-employed, in paid employment; *not working*: unemployed, retired, unable to work), type of cancer, type of treatment, time since completion of primary treatment, aftercare, comorbidities, length and weight (body mass index [BMI]). Although other variables were also assessed, these were not used for the current study. *Following specific modules* and the *number of weeks since first login* were derived from program logging data.

Sample size

Sample size calculation revealed that each intervention condition needed to contain 144 participants (effect size = .30; one sided $\alpha = 0.05$; $\beta = 0.2$; power = 80%); intra-class correlation coefficient (ICC) = .005). With an expected dropout of some 20% - 23%, the required sample size was $N = 376$ (188 per condition) at baseline.

Statistical analyses

Preparatory and descriptive analyses were conducted using SPSS 22, and for calculation of the intervention effects, STATA version 13.1 was applied. The dataset was assessed for outliers and aberrant measurement data.

Baseline differences between IC and UC concerning lifestyle behaviors, demographic and cancer-related characteristics were examined using independent t-tests and chi-square tests. Selective dropout was assessed by applying logistic regression analysis with dropout as outcome variable (0 = no; 1 = yes) and group assignment and baseline characteristics as predictive factors.

In order to measure intervention effects at follow-up in PA and dietary behavior, multilevel linear regression analysis (MLA) was applied. A two-level data structure was used with individuals (level 1) nested within hospitals (level 2), taking the possible aftercare differences between hospitals into consideration because there might be interdependence between participants from the same hospital. Model testing proceeded in two phases, the *crude* and *adjusted* analyses, in line with Twisk (2006). The crude model included the dependent variable (behavior), the intervention condition (0 = UC, 1 = IC), and the baseline value of the outcome behavior as fixed intercepts with random slopes, and hospital as random

intercept. All random parameters were added with an independent data structure. Next, the crude model was adjusted for standard demographic and disease-related characteristics, significant variables from dropout analysis, and baseline differences: i.e., gender, age, marital status, education level, income level, employment status, BMI, type of cancer, having had cancer before, type of treatment, time since completion of primary cancer treatment, aftercare, comorbidities, vegetable, fruit, whole grain bread and fish intake at baseline. These variables were added as fixed intercepts and dummy-coding was used for categorical variables including more than two categories.

For testing the effect of following a specific module, *intervention condition* was categorized into three categories (0 = UC, 1 = IC, specific module not followed, 2 = IC, specific module followed) in the fully adjusted MLA-models.

Analyzing the intervention effect on smoking behavior after six months by using multilevel logistic regression analysis was not possible due to the small number of smokers. Chi-square tests were applied to assess differences between IC and UC at baseline and follow-up.

Cohen's *d* effect sizes were calculated for the main effect results on PA and dietary behavior by dividing the difference between the relevant two means of IC en UC at follow-up by the pooled standard deviations of those means (Cohen, 1992). For the sub-analysis of following modules (*yes*, *no*), Cohen's *d* was adjusted for the baseline value by dividing the difference between the means of the relevant change scores by the pooled standard deviation of those means. Additionally, Cohen's f^2 was calculated in order to evaluate the local effect size within the context of the fully adjusted MLA model with $f^2 \geq .02$, $f^2 \geq .15$, and $f^2 \geq .35$ represent small, medium, and large effect sizes, respectively (Cohen, 1992; Selya, Rose, Dierker, Hedeker, & Mermelstein, 2012). To index the magnitude of the effect for smoking, as according to Durlak (2009), the odds ratios (OR) were calculated by comparing the odds of smoking cessation for the intervention group with the odds of smoking cessation for the control group.

For generating computer tailored messages within the intervention, it was necessary that respondents filled out all questions of the baseline measurement. Consequently, only those respondents, who completed the baseline measurement without missing data were included in analyses. To assess the intervention effects among respondents who also participated during the follow-up measurement, only complete cases were analyzed. This means that cases with missing data at the follow-up measurement were excluded. Besides that, intention-to-treat analysis (ITT) has been conducted in order to additionally display unbiased estimates of the intervention effects (Montori & Guyatt, 2001). For PA and dietary behavior outcomes, multiple imputation analyses were conducted by including all variables of the fully adjusted MLA model into the multiple imputation process and using 20 imputed datasets. This is in accordance with the argumentation of Enders (2010). With regard to smoking outcomes, for ITT, participants who were identified as smokers at baseline were

accounted as smokers if their smoking status after six months could not be determined (West, Hajek, Stead, & Stapleton, 2005).

By exploring effects on multiple outcomes in dietary behavior and PA, type 1 error might occur due to multiple comparisons. The false discovery rate correcting procedure (FDR) of Benjamini and Hochberg (1995) was applied to account for multiple testing problems which is a more powerful procedure as compared to procedures controlling the traditional familywise error rate (Benjamini & Yekutieli, 2001).

RESULTS

An overview of the reach and attrition of the intervention participants is provided in Figure 5.1. In total, 462 cancer survivors were included for analysis at baseline (IC: n = 231, UC: n = 231), and 409 participants filled out the follow-up questionnaire (11.5% dropout). From the analyses concerning PA outcomes, 10 cases were excluded due to extreme over reporting (> 6720 minutes p/w PA), according to the scorings manual of Wendel-Vos & Schuit (2004). The sample characteristics at baseline and lifestyle behavior at baseline and after six months are displayed in Table 5.1. Significant baseline differences between groups were type of treatment, and consumption of vegetable, whole grain bread and fish. Dropout was higher in the IC (n = 43, 18.6%) than in the UC (n = 10, 4.3%). Significant predictors for dropout were allocation to IC (B = 1.998, SE = .410; p = .000), male gender (B = 1.490, SE = .681, p = .029), lower modal income (B = -1.155, SE = .513; p = .025), lower vegetable consumption (B = -.008, SE = .003; p = .014), and higher fruit consumption (B = .374, SE = .153; p = .014).

The IC-participants, included into the complete cases analyses, followed on average 2.23 (SD = 1.58) KNW-modules. The module PA was followed by 45 (24.7%), and the module Diet was followed by 116 (61.7%) of included IC-participants. Within the module Diet, 41 (21.8%) IC-participants set a goal to increase their vegetable consumption, 24 (12.8%) wanted to increase their fruit consumption, 22 (11.7%) set a goal to increase their fish consumption, 43 (22.9%) wanted to increase the intake of whole grains, and 10 (5.3%) set no specific goal. About 80% followed the module Diet and/or the module PA within 14 weeks after getting access to the KNW. The module Smoking was followed by 19 (10.1%) of the IC-participants included into the complete cases analyses. Almost 95% of them followed this module within 15 weeks after getting access.

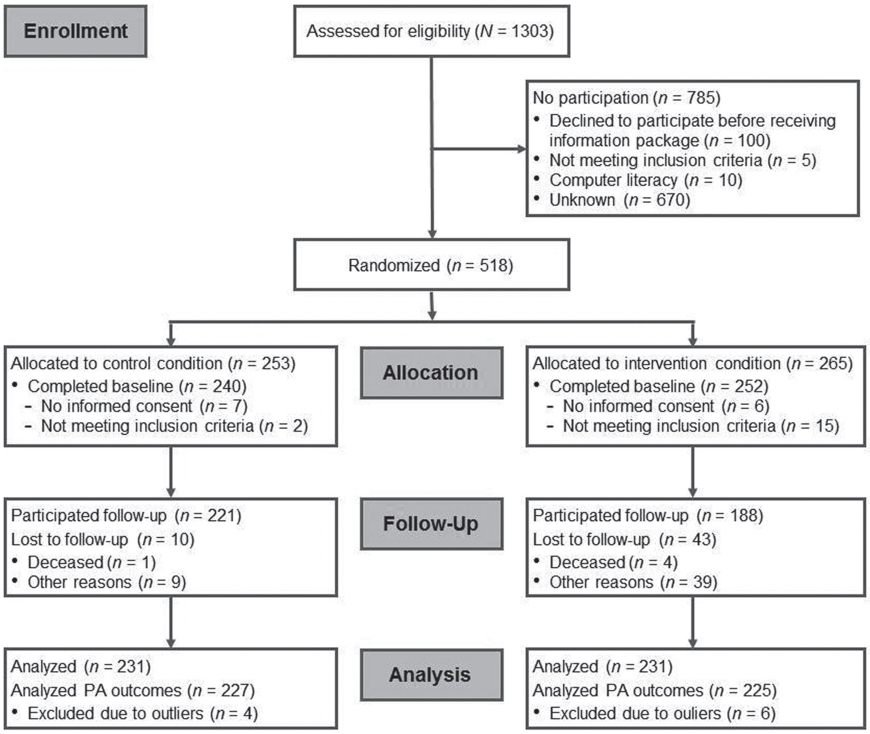

Figure 5.1 Flow diagram of the reach and attrition of the KNW-intervention participants

Physical activity

Effects of having access to the KNW on PA after 6 months

As displayed in Table 5.2, significant differences were found in change over time concerning moderate PA (B = 117.738, p = .037, $p\ fdr$ = .148, d = -.25, f^2 = .007) between IC and UC. However, these differences did not remain significant after controlling for multiple testing. No significant intervention effects were found in the other PA outcomes. Their effect sizes ranged from d = .01 to 0.10; f^2 = .000 to .006)

Effects of following module PA on PA outcomes

As shown in Table 5.3, a significant higher increase in moderate PA was found among users of the PA module (B = 179.609, p = .022, $p\ fdr$ = .120, d = -0.32, f^2 = 0.013) compared to participants who did not follow the PA module. This effect did not remain significant after correction for multiple testing.

Table 5.1 Sample characteristics and lifestyle behaviors at baseline and after six months

Sample characteristics	Baseline		Lifestyle behavior[1]	Baseline		After six months	
	Intervention group (*N* = 231)	Control group (*N* = 231)		Intervention group	Control group	Intervention group	Control group
Female, *n* (%)	183 (79.2)	186 (80.5)	Weekly days > 30 min PA, *M* (*SD*)	4.93 (1.87)	4.62 (2.02)	5.11 (1.89)	4.94 (1.84)
Age, *M* (*SD*)	55.6 (11.5)	56.2 (11.3)	Change			0.18	0.31
With partner *n* (%)	193 (83.5)	184 (79.7)	Light PA min p/w, *M* (*SD*)	1521.46 (897.86)	1430.23 (897.67)	1566.15 (960.78)	1660.62 (992.33)
Resident children, *n* (%)	78 (44.1)	82 (44.6)	Change			44.69	230.39
Low education, *n* (%)	76 (32.9)	97 (42)	Moderate PA min p/w, *M* (*SD*)	595.91 (620.50)	525.44 (545.50)	746.64 (676.31)	601.43 (510.90)
Medium education, *n* (%)	76 (32.9)	70 (30.3)	Change			150.73	75.99
High education, *n* (%)	79 (34.2)	64 (27.7)	Vigorous PA min p/w, *M* (*SD*)	231.00 (323.88)	238.02 (426.03)	317.95 (458.36)	314.46 (489.92)
Employed, *n* (%)	122 (52.8)	111 (48.1)	Change			86.95	76.44
Not employed, *n* (%)	109 (47.2)	120 (51.9)	Vegetable intake, g p/d, *M* (*SD*)	138.47 (67.92)	124.17 (57.53)	146.58 (55.98)	124.92 (60.84)
Income below average, *n* (%)	28 (12.1)	42 (18.2)	Change			8.12	0.75
Income average, *n* (%)	84 (36.4)	78 (33.8)	Fruit intake, servings p/d, *M* (*SD*)	1.78 (1.23)	1.59 (1.03)	1.87 (0.94)	1.72 (1.08)
Income above average, *n* (%)	119 (51.5)	111 (48.3)	Change			0.10	0.13
Working hours p/w, *M* (*SD*)	16.2 (12.0)	16.8 (13.6)	Whole gr. bread, slices p/d, *M* (*SD*)	3.12 (1.81)	2.81 (1.51)	3.21 (1.48)	2.88 (1.45)
BMI, *M* (*SD*)	26.0 (5.0)	26.5 (4.9)	Change			0.09	0.08
Breast cancer, *n* (%)	162 (70.1)	164 (71)	Fish, servings p/w, *M* (*SD*)	1.86 (1.93)	1.35 (1.30)	2.46 (2.75)	1.77 (2.24)
Other cancer type, *n* (%)	69 (29.9)	67 (29)	Change			0.60	0.42
Surgery, chemo, radiation, *n* (%)	86 (37.2)	108 (46.8)	Smoking behavior total sample				
Surgery, chemo, *n* (%)	61 (26.4)	48 (20.8)	Current smokers	27 (11.7%)	32 (13.9%)	18 (10.2%)	28 (13.5%)[3]
Surgery, radiation, *n* (%)	46 (19.9)	30 (13)	Change			-9	-4
Other type of treatment, *n* (%)	38 (16.5)	45 (19.5)	Course smoking behavior[2]				

Table 5.1 Sample characteristics and lifestyle behaviors at baseline and after six months *(Continued)*

Sample characteristics	Baseline		Lifestyle behavior[1]	Baseline		After six months	
	Intervention group (*N* = 231)	Control group (*N* = 231)		Intervention group	Control group	Intervention group	Control group
Aftercare, yes, *n* (%)	145 (62.8)	141 (61)	*Complete cases n = 50*				
No. aftercare activities, *M* (*SD*)	1.1 (1.1)	1 (1.0)	Persistent smokers			18 (81.8%)	26 (92.9%)
Comorbidity, yes, *n* (%)	62 (26.8)	63 (27.3)	Quitters			4	2
No. comorbidities, *M* (*SD*)	0.3 (0.6)	0.4 (0.7)	*Intention-to-Treat n = 59*				
Time since primary treatment, No. of weeks, *M* (*SD*)	25.1(13.5)	23.4 (12.9)	Persistent smokers			23 (85.2%)	30 (93.8%)
			Quitters			4	2

Note.: Abbreviations: BMI: Body Mass Index, *M* = mean; *SD* = standard deviation; chemo = chemotherapy;
No = number; PA = physical activity; IC = intervention group; UC = usual care control group; g = grams;
[1] Baseline: PA: IC: *n* = 225; UC: *n* = 227; dietary outcomes: IC: *n* = 231; UC: *n* = 231; 6-month follow-up: PA: IC: *n* = 178; UC: *n* = 216; dietary outcomes: IC: *n* = 184; UC: *n* = 219
[2] Never smokers (IC: *n* = 114, UC: *n* = 109) excluded.
[3] Two of the current smokers at 6-month follow-up did not smoke at baseline

Table 5.2 Results from multilevel analysis of the overall intervention effects on Physical Activity and Diet

	Complete cases analysis[1]						Intention-to-treat analysis[2]			
	B	*SE* [95% CI]	*p*	*p fdr*	*d* [95% CI]	f^2	*B*	*SE* [95% CI]	*p*	*p fdr*
Physical activity outcomes										
Weekly days >30 min										
Crude	.01	0.17 [-.32; .33]	.963	.963			-.08	0.16 [-.40; .23]	.586	.700
Adjusted	.01	0.04 [-.31; .33]	.955	.955	-.10 [-.29; .10]	.000	-.11	0.16 [-.423; .19]	.460	.526
Light PA min p/w										
Crude	-126.47	83.99 [-291.11; 38.16]	.132	.264			-117.85	83.96 [-282.48; 46.79]	.161	.302
Adjusted	-125.59	81.57 [-258.47; 34.29]	.124	.331	.10 [-.10; .30]	.006	-130.57	80.09 [-287.63; 26.49]	.103	.275
Moderate PA min/ p/w										
Crude	96.45	51.77 [-5.02; 197.93]	.062	.248			122.18	60.61 [2.82; 241.53]	**.045**	.180
Adjusted	117.74	56.45 [7.10; 228.38]	**.037**	.148	-.25 [-.45; -.05]	.007	125.24	60.49 [6.06; 244.41]	**.040**	.160
Vigorous PA min/ p/w										
Crude	-5.31	40.15 [-83.99; 73.38]	.895	.963			2.66	[-77.37; 82.69]	.948	.948
Adjusted	-25.61	38.99 [-102.02; 50.81]	.511	.584	.01 [-.21; .19]	.002	-15.94	[-94.99; 63.11]	.692	.692

Table 5.2 Results from multilevel analysis of the overall intervention effects on Physical Activity and Diet *(Continued)*

	Complete cases analysis[1]						Intention-to-treat analysis[2]			
	B	*SE* [95% CI]	*p*	*p fdr*	*d* [95% CI]	f^2	*B*	*SE* [95% CI]	*p*	*p fdr*
Dietary behavior outcomes										
Vegetables (g/p/d)										
Crude	10.26	4.10 [2.23; 18.30]	**.012**	.096			11.16	4.19 [2.94; 19.38]	**.008**	.064
Adjusted	9.15	4.10 [1.03; 17.27]	**.027**	.148	-.37 [-.57; -.17]	-.013	9.57	4.21 [1.32; 17.82]	**.023**	.160
Fruit (servings p/d)										
Crude	.08	0.07 [-.06; .23]	.242	.323			.07	0.08 [-.08; .22]	.339	.452
Adjusted	.08	0.07 [-.06; .23]	.271	.433	-.15 [-.35; .05]	.002	.07	0.08 [-.08; .22]	.351	.468
Whole grain bread (p/d)										
Crude	.15	0.12 [-.08; .38]	.195	.312			.15	0.12 [-.08; .39]	.189	.302
Adjusted	.11	0.12 [-.12; .34]	.354	.472	-.22 [-.42; -.02]	.000	.11	0.12 [-.12; .34]	.330	.468
Fish (servings p/w)										
Crude	.37	0.23 [-.09; .82]	.113	.264			.34	0.24 [-.13; .82]	.157	.302
Adjusted	.32	0.23 [-.14; .77]	.173	.346	-.28 [-.47; -.08]	.004	.32	0.24 [-.17; .80]	.198	.396

Note: Multilevel analysis with two-level data structure: persons (level1) nested in hospitals (level2); *B* = Regression coefficient, *d* = Cohen's *d*, f^2 = Cohen's f^2. PA = physical activity; p/w = per week, p/d = per day. Crude analysis: models includes intervention condition, outcome behavior at baseline, and hospital; adjusted analysis: adjusted for gender, age, marital status, education level, income level, employment, baseline BMI, cancer type, having had cancer before, treatment type, time since last treatment, participation in aftercare, comorbidities, baseline vegetable, fruit, bread, and fish consumption.

[1] For physical activity outcomes *N* = 394; for diet outcomes *N* = 403

[2] Imputed data: for physical activity outcomes *N* = 452; for diet outcomes *N* = 462

Table 5.3 Effects of following the behavior-related modules on Physical Activity and Diet six months after getting KNW-access

	B	*SE* [95% CI]	*d* [95% CI]	f^2	*p*	*p fdr*
Physical Activity, UC = ref.						
Numbers of days PA						
Module PA used	.362	.25 [-.14; .86]	-.32 [-.64; .00]	.012	.154	.246
Module PA not used	-.121	.18 [-.47; .22]	.22 [.00; .43]	.002	.492	.656
Light PA						
Module PA used	-119.605	128.82 [-372.08; 132.87]	.13 [-.19; .45]	.006	.353	.403
Module PA not used	127.717	88.90 [-301.95; 46.52]	.16 [-.05;.38]	.005	.151	.402
Moderate PA						
Module PA used	197.609	86.09 [28.88; 366.33]	-.32 [-.64; -00]	.013	**.022**	.120
Module PA not used	91.956	61.96 [-29.07; 212.98]	.02 [-.19; 24]	.006	.136	.402
Vigorous PA						
Module PA used	34.531	61.34 [-85.70; 154.76]	-.19 [-.52; .13]	-.000	.573	.573
Module PA not used	-47.259	42.39 [-130.34; 35.82]	.05 [-.16; .27]	.004	.265	.530
Dietary behavior, UC = ref.						
Vegetable consumption						
Module Diet used	7.86	4.81 [-1.55; 17.30]	-.09 [-.31; .14]	-.004	.102	.204
Module Diet not used	11.123	5.62 [.11; 22.14]	-.23 [-.50; .04]	-.018	**.048**	.384
Fruit consumption	7.876					
Module Diet used	.181	.08 [.02; .35]	-.12 [-.35; .10]	.016	**.031**	.120
Module Diet not used	-.075	.10 [-.27; .12]	.05 [-.22; .32]	.006	.444	.656
Fish consumption						
Module Diet used	.542	.27 [.01; 1.07]	-.11 [-.34; .11]	-.002	**.045**	.120
Module Diet not used	-.021	.31 [-.63; .59]	.03 [-.24; .30]	.000	.946	.965
Bread consumption						
Module Diet used	.177	.14 [-.09; .44]	-.02 [-.25; .21]	-.000	.191	.254
Module Diet not used	.001	.16 [-.30; .31]	.03 [-.23- .31]	.002	.965	.965

Note: Effect of module use was tested using three categories: 0 = UC, 1 = IC, specific module not used; 2 = IC, specific module used. Results of the fully adjusted models are displayed. Dietary outcomes: *N* = 403, PA outcomes *N* = 394. IC = intervention condition, UC = usual care control condition, ref = reference group, PA = physical activity; *p fdr* = controlling for false discovery rate; *d* = Cohen's *d* (corrected for baseline value), f^2 = Cohen's f^2: $f^2 \geq 0.02$, $f^2 \geq 0.15$, *and* $f^2 \geq 0.35$ represent small, medium, and large effect sizes

Diet behavior

Effects of having access to the KNW on dietary behavior after six months

Significant intervention effects on vegetable consumption using the fully adjusted MLA-model (complete cases: *B* = 9.15, *p* = .027, *p fdr* = *.148, d* = -.37, f^2 = -.013; ITT: *B* = 9.57, *p* = .023, *p fdr* = .160) did not remain significant after accounting for multiple testing. No significant effects of having access to the KNW were found on the other dietary behavior outcomes after six months. Results are displayed in Table 5.2.

Effects of following module Diet on diet behavior

As displayed in Table 5.3, users of the module Diet had a significantly higher increase in fruit (B = .181, p = .031, p *fdr* = .120, d = -.12, f^2 = .016) and fish intake (B = .542, p = .045, p *fdr* = .120 d = -.11, f^2 = -.002) after six months. A significant increase in vegetable consumption was found among participants who did not follow module Diet (B = 11.123, p = .048, p *fdr* = .384, d = -.23, f^2 = -.018). However, after controlling for multiple comparisons, these results did not remain significant (Table 5.3).

Smoking behavior after six months

At baseline, 27 (11.7%) respondents of the IC, and 32 (13.9%) respondents of the UC were current smokers (Table 5.1). After six months, respectively 18 (7.8%) and 28 (13.5%) respondents of IC and UC were current smokers. From the smokers at baseline, 18 (81.8%) were persistent smokers and four (18.8%) were quitters after six months in the IC. In the UC, 26 (92.9%) were persistent smokers and two (7.1%) were quitters after six months. No significant intervention effect was found between groups at follow-up (χ^2 = 1.42, p = .233, *OR* 2.89). ITT revealed comparable results (χ^2 = 1.18, p = .278, *OR* = 2.61; *Chi-square tests* are not displayed in Table 5.1).

DISCUSSION

The present RCT evaluated the effects of the web-based, computer tailored, multiple behavior KNW intervention on lifestyle outcomes, i.e., PA, diet (vegetable, fruit, whole grain bread and fish consumption), and smoking behavior after six months. The presented outcomes point in the direction that the KNW may affect moderate PA and dietary behaviors. Cancer survivors who had access to the KNW showed larger increases in moderate PA and vegetable consumption, and using the specific modules resulted in a larger increase of moderate PA, and larger increases in fruit and fish consumption. These effects need to be interpreted with caution, however, since results did not remain significant after correction for multiple testing.

The loss to follow-up after six months was low (11.5%) in comparison with the mean percentage of dropouts (19.7%) of web-based trials for cancer survivors (Kuijpers et al., 2013). This suggests a strong commitment that may be attributed to an evident need of cancer survivors for support after completion of primary cancer treatment (Willems et al., 2016). This period can be considered as a teachable moment. Additionally, low dropout in the UC after six months (Figure 5.2) suggests that allocation to the waiting list UC was well accepted by the participants.

Physical activity

The increase in moderate PA in the IC that was found in the main analysis (having KNW-access) was confirmed when testing the use of the specific PA module. The effect size of moderate PA-changes ($d = .32$) was higher when testing the use of the PA module compared to the main analysis ($d = .25$). In comparison with prior, web-based PA-only interventions, these effect sizes were similar or even higher than the earlier reported overall effect size of $d = .14$ (Davies, Spence, Vandelanotte, Caperchione, & Mummery, 2012). Possibly, the module PA was followed by cancer survivors who were actually "in need" and able to increase PA. This might indicate that the KNW-recommendation on PA could have targeted the desired subpopulation. The low number of module PA-followers ($n = 45$) might possibly have caused power problems, which might be a reason for the non-significant results after controlling for multiple testing. Moreover, the raw data (Table 5.1) of increases in moderate PA (+150.73 min p/w) in the IC was notably higher as compared to the UC (+75.99 min p/w). This may be interpreted as a meaningful result, considering findings from Wen et al. (2011) that every additional 15 minutes a day or 90 minutes a week of moderately intense PA reduced all-cancer mortality. This dose-response relationship has been confirmed in recent publications (Arem et al., 2015; Samitz, Egger, & Zwahlen, 2011; Schmid & Leitzmann, 2014). The module PA was derived from an existing, basic web-based PA intervention for the general population aged over 50, named Active Plus (Peels et al., 2014b; Willems et al., 2015), which has been shown to be effective in increasing weekly minutes of moderate and vigorous PA after six months ($d = .24$). The increase of combined moderate and vigorous PA was higher in the Active Plus intervention in comparison to the KNW-intervention (283 min vs. 238 min p/w). Reasons for these differences might be the target population (general population in Active Plus vs. cancer survivors in KNW) and the program intensity (three tailored sessions within six months in Active Plus vs. one combined tailored session followed by an evaluation four weeks later in KNW). In addition, the module PA was one of eight modules in the KNW, while the Active Plus intervention consisted of only the theme on PA. In addition, there might have been more selective attrition in Active Plus due to higher dropout (close to half of the sample).

Dietary behaviors

The effects of the KNW on dietary behavior are valuable to mention although they remained not significant after accounting for multiple testing. It is promising that participants who had access to the KNW showed a higher vegetable consumption. As can be concluded from the sub-analyses, this increase in vegetable consumption could not be explained by following the module Diet. Possibly, the increase in vegetable consumption might be attributed to other intervention components, such as one of the news items that targeted

the topic diet very extensively, and which were distributed to all IC-participants. The module Diet was followed by more than 60% of the participants, which suggests that this module was popular, and possibly not only visited based on the provided recommendation, but also based on self-selection. Those, who followed the module Diet, had a higher increase in fruit and fish consumption. A possible explanation for the effect on fish consumption might be attributed to an increase in knowledge about the health advantages of consuming fatty fish, and that consuming fatty fish twice a week may be a healthier choice than eating red and processed meat on daily basis. With regard to the effect on fruit consumption, higher increases in fruit consumption on daily basis might be easier to achieve than changes in other diet habits. Furthermore, it was not possible to choose more than two goals within the module Diet, which resulted in the lower numbers of participants who set goals on the specific dietary outcomes. This might be an explanation for the non-significant results after correction for multiple testing.

The effect size for changes in vegetable consumption (d = .37) in the present study was in line with the effect size of a Dutch web-based, computer tailored, diet-only education intervention for adults in the general population (d = .32; Springvloet, Lechner, de Vries, & Oenema, 2015). Also Goode et al. (2015) reported comparable effect sizes (d = .16 to d = 1.71) for non-face-to-face interventions on fruit and vegetable outcomes. Most of these reported studies included intensive (telephone) counseling for cancer survivors. In contrast, the module Diet included less separate sessions, however, showed comparable outcomes. In addition, the web-based multiple behavior intervention for cancer survivors reported by Bantum et al. (2014) was not effective in changing dietary behavior, although not accounting for multiple testing. Parsons et al. (2008) also reported significant changes in vegetable consumption, but not in other dietary behaviors, six months after diet telephone counseling among prostate cancer patients.

Notably, the average consumption of vegetables, fruit, and whole grain bread were below recommended levels among the whole sample at both time points. These results confirm findings from research among Dutch cancer survivors, reporting that only 27.4% has met the vegetable recommendations (Kanera et al., 2016a). Additionally, a low overall intake of healthy food has been reported in several studies (Blanchard et al., 2008; Vijayvergia & Denlinger, 2015; Zhang et al., 2015). At the same time, recent observations revealed that particularly early cancer survivors were more likely to meet the vegetable and fruit recommendations (Bluethmann et al., 2015; LeMasters et al., 2014). Still, as our results suggest, there is a lot of room for improvement in dietary behaviors among cancer survivors, and intervening shortly after completing primary treatment seems to be a very relevant period and apparently a teachable moment.

Smoking behavior

No significant intervention effects have been found for smoking behavior after six months. However, the likelihood of giving up smoking was almost three times higher in the IC than in the UC (*OR* = 2.89). Nonetheless, this has to be interpreted with caution due to the limited amount of smokers in our study population. With higher numbers of smokers and the possibility to apply multilevel logistic regression analysis, it could be expected that significant results might occur in favor of the IC.

Multiple behavior interventions

This multiple behavior KNW intervention was especially designed to cover a broad range of relevant topics to meet the various cancer survivors' needs (Kanera et al., 2016a; Willems et al., 2016). Besides targeting PA, diet, and smoking, the KNW also offered modules targeting fatigue, anxiety and depression, relational problems, return to work, and residual problems. The lifestyle modules included less separate sessions as compared to other multiple health behavior change interventions for cancer survivors (Bantum et al., 2014; Goode et al., 2015; Green, Hayman, & Cooley, 2015). This could be a possible reason for the limited effects of the KNW on lifestyle. Moreover, it might have been difficult for cancer survivors to focus on numerous topics. Most of the participants visited two modules, and possibly, for some of the participants the psychosocial topics had a higher priority. Earlier research revealed that in the first year after cancer treatment, residual and psychosocial problems might impede lifestyle change (Bluethmann et al., 2015). Furthermore, within the KNW, the number of recommendations to follow a certain module varied individually with a broad range from zero to eight. This was dependent on the responses given at baseline. Wilson et al. (2015) described that intervention effects might be curvilinear related to the number of recommendations given, with a moderate number of recommendations being most beneficial among the general population.

Limitations

This RCT provided insightful and valuable findings despite the limited effects on lifestyle behaviors. Nevertheless, some limitations should be acknowledged. Regarding generalizability, the KNW participants were mainly middle-aged breast cancer survivors with an (above) average income level, and with little comorbidity. This might be too selective to represent the general cancer survivor population. However, these findings are in line with the prevalence of breast cancer in the Netherlands (Comprehensive Cancer Centre the Nederlands, 2011b), and with Kohl et al. (2013), confirming a higher reach of web-based interventions among female participants with higher socioeconomic status. Furthermore, the intervention tested is an eHealth intervention and participation demanded

that participants had Internet access and sufficient computer skills. These intervention characteristics can also explain the overrepresentation of middle-aged participants.
Present results might have been influenced by the selective dropout. However, the dropout rate was very low, analyses were corrected for the corresponding variables, and intention-to-treat analyses revealed comparable results to complete cases analyses. Besides this, health behaviors were measured using self-report questionnaires, thus allowing over- and underestimations to occur due to social desirability or recall bias (van Assema, Brug, Ronda, Steenhuis, & Oenema, 2002). Although the self-administrated questionnaires were validated, easy to apply, inexpensive, and have often been used in large-scale studies, we may presume that overestimation occurred in PA (van den Brink, 2005; Campbell et al., 2015; de Hollander et al., 2012; Helmerhorst, Brage, Warren, Besson, & Ekelund, 2012; Mudde et al., 2006; Te Poel et al., 2009; Wendel-Vos et al., 2003). The proportion of smoking cessation might be slightly underestimated, due to accounting smokers at baseline as smokers in intention-to-treat-analyses if their smoking behavior could not be measured after six months.
Prior to the baseline assessment, the participants knew about their group-assignment, which might have influenced the responses on the baseline questionnaire. We assume, however, that the baseline differences in dietary behavior occurred merely by chance, given the comparable response of participants in both intervention conditions at baseline. There were also no differences in PA and smoking behavior at baseline. In addition, in this RCT, the intervention was compared to a usual-care control group, who possibly participated in other aftercare interventions. Multilevel linear regression analysis was applied for addressing possible differences in (after-) care between the different hospitals, and all analyses were corrected for aftercare-use.

CONCLUSIONS

Having access to the KNW and following the KNW modules do affect lifestyle behaviors, although to a limited extent. Meaningful increases in moderate PA were detected in the IC, and the effect size of the increase in vegetable consumption was higher than in comparable studies. Moreover, the outcomes point in the direction that following the module Diet could affect fruit and fish consumption. Non-significant results after accounting for multiple testing in moderate PA, vegetable, fruit and fish consumption might be due to the high number of outcomes and the low numbers of module users who set a goal on the specific outcome behavior. No significant intervention effect was found on smoking behavior due to the low number of smokers. An exploration of the use of this complex KNW intervention is recommended to get further insights into underlying mechanisms, and to improve the intervention effectiveness. Overall, results provide preliminary indications that this theory-based, broad-scoped, computer tailored web-based cancer aftercare intervention can provide valuable support in usual cancer aftercare.

Long-term effects of a web-based cancer aftercare intervention on moderate physical activity and vegetable consumption among early cancer survivors. A randomized controlled trial

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ABSTRACT

Background

The number of cancer survivors is growing. Negative physical and psychosocial consequences of cancer treatment can occur during survivorship. Following healthy lifestyle recommendations is beneficial to increase quality of life and to reduce the risk of cancer recurrence and comorbidities. To meet individual needs, web-based interventions can supply a large population of cancer survivors with easily accessible and personalized information. Evidence concerning the long-term effects of web-based cancer aftercare interventions on lifestyle outcomes is limited. The present study evaluates the 12-month effects of a fully automated web-based cancer aftercare intervention. We investigated whether the previously determined 6-month effects on moderate physical activity and vegetable intake were maintained over 12 months. Possible moderator effects of using specific intervention modules, gender, age, and education were also explored.

Method

A two-armed randomized controlled trial was conducted using online self-report questionnaires among survivors of various types of cancer ($N = 462$). The intervention group had access to the online intervention for six months, and the control group received access after 12 months. Multilevel linear regression analyses (complete cases and intention-to-treat) were conducted to explore 12- month effects.

Results

A significant intervention effect after 12 months was found for moderate physical activity (complete cases: $B = 128.475$, $p = .010$, $d = .35$; intention-to-treat: $B = 129.473$, $p = .011$). Age was the only significant moderator ($p = .010$), with the intervention being effective among participants aged younger than 57 years ($B = 256.549$, $p = .000$, $d = .59$). No significant intervention effect remained for vegetable consumption after 12 months (complete cases: $B = 5.860$, $p = .121$; intention–to-treat: $B = 5.560$, $p = .132$).

Conclusions

The online cancer aftercare intervention is effective in increasing and maintaining moderate physical activity in the long term among early cancer survivors younger than 57 years. Short-term increases in vegetable consumption were not sustained in the long term. These findings indicate the value and potential of eHealth interventions for cancer survivors. Based on the study results, web-based self-management interventions could be recommended for cancer survivors younger than 57 years of age in order to increase physical activity.

BACKGROUND

Cancer represents a large global health problem, with approximately 14.1 million new cases of cancer in 2012, worldwide (World Health Organization, 2017; Cancer Research UK, 2016). Due to aging and improvements in treatment, the number of cancer survivors is growing. As a consequence of primary cancer treatment, cancer survivors' quality of life (QoL) can be reduced by physical and psychosocial health problems, such as pain, fatigue, anxiety, depression, and work-related issues (Aaronson et al., 2014; Deckx et al., 2015). Moreover, survivors are at risk of disease recurrence, and comorbid chronic conditions (Kenzik, Kent, Martin, Bhatia, & Pisu, 2016). In particular, survivors who smoke, are physically inactive, or overweight are at increased risk for mortality, morbidity, and disability (Bruno et al., 2016; Schmid & Leitzmann, 2014; Tsilidis et al., 2016). A healthy dietary pattern has been associated with a lower risk of obesity, hypertension, and unfavorable cholesterol and glucose blood levels, which in turn may be related to a lower risk of cancer recurrence (Bruno et al., 2016). Particularly, the consumption of vegetables has been associated with a lower risk of cancer recurrence among breast cancer survivors (Thomson et al., 2011). Moreover, a growing body of evidence has shown that cancer survivors' QoL can be improved by adopting and maintaining a healthy lifestyle (Baena Ruiz & Salinas Hernandez, 2013; Bruno et al., 2016; Carmack et al., 2011; Husson et al., 2015; Koutoukidis et al., 2015; Schmid & Leitzmann, 2014; Smits et al., 2015; Thomson et al., 2011). For example, physical activity (PA) has been shown to improve psychological outcomes, fatigue, body composition, walking distance, aerobic fitness, strength, and QoL domains (Fong et al., 2012; Mishra et al., 2014; Van Dijck et al., 2016). In particular, aerobic exercise with moderate-intensity appeared to be a strong positive factor affecting fatigue, walking endurance, and cancer mortality (Dennett, Peiris, Shields, Prendergast, & Taylor, 2016; Inoue-Choi et al., 2013). According to the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) and the American Cancer Society (Blanchard et al., 2008; Inoue-Choi et al., 2013; World Cancer Research Fund, 2009; Rock et al., 2012), adult cancer survivors should avoid inactivity. It is recommended that cancer survivors engage in at least 150 minutes per week (min p/w) of moderate PA, spread throughout at least 5 days of the week, or perform 75 min p/w of vigorous PA (or an equivalent combination). A healthy diet should include at least five servings of fruit and vegetables daily (Rock et al., 2012). Despite the beneficial effects of recommended PA and healthy diet, the great majority of cancer survivors fail to meet the lifestyle recommendations (Blanchard et al., 2008; DeNysschen et al., 2015; Kanera et al., 2016a; Mowls et al., 2016).

Meeting the individual needs of a growing number of cancer survivors, including the promotion of a healthy lifestyle, is challenging. Therefore, fully automated web-based interventions may be appropriate for providing a large population with easily accessible and low-cost support that can be personalized by applying computer tailoring (Chou et al., 2011; de Vries & Brug, 1999; Kohl et al., 2013; Noar et al., 2007). Moreover, web-based interventions

fit with the increasing demand for online health-related information, may stimulate self-care, and might complement a stepped care approach within cancer aftercare (Aaronson et al., 2014; Chou et al., 2011; Given & Given, 2013; Krebber et al., 2012; Runowicz et al., 2016). Although a growing number of web-based self-management interventions have been developed for cancer survivors in recent years, only a few web-based studies evaluated PA and/or diet outcomes (Bantum et al., 2014; Goode et al., 2015; Kim & Park, 2015; Kuijpers et al., 2013; Lee et al., 2014). Post intervention increases in moderate PA and/or vegetable intake have been reported, however, behavior change was not maintained at 6-month follow-up (Bantum et al., 2014; Lee et al., 2014; Rabin, Dunsiger, Ness, & Marcus, 2011; Valle, Tate, Mayer, Allicock, & Cai, 2013). Although younger, female, and higher educated survivors often participated in web-based interventions, it is unknown whether and which possible subgroups of cancer survivors might benefit most from web-based lifestyle interventions (Kohl et al., 2013). This can be important knowledge to integrate web-based interventions into cancer aftercare.

The web-based intervention *Kanker Nazorg Wijzer* (Cancer Aftercare Guide, KNW) is a computer-tailored intervention that ultimately aims to increase survivors' QoL (Willems et al., 2015). The online portal comprises eight separate modules that target the topics PA, diet, smoking cessation, return-to-work, fatigue, anxiety and depression, social relationships, and residual problems. Survivors of various types of cancer had access to the fully automated web portal for six months. Previously reported findings revealed strong indications that having access to the KNW may account for meaningful increases in moderate PA and vegetable consumption after six months of access, while using the behavior specific modules accounted for higher increases of moderate PA and higher fruit and fish consumption (Kanera et al., 2016b).

The aim of the present study is to examine the long-term (12-month) effects of the web-based KNW on moderate PA and vegetable consumption, in order to evaluate whether the KNW outcomes on moderate PA and vegetable intake that were found six months after the baseline measurement were maintained in the long term. In addition, we explored whether possible effects on the behavioral outcomes (i.e. moderate PA, vegetable intake) were influenced by whether or not participants visited the module that was directed at the behavior in question. This procedure was in line with the 6-month evaluation (Kanera et al., 2016b). To identify possible subgroups that might benefit most from this intervention, we explored whether a possible intervention effect was moderated by gender, age, and educational level.

METHODS

Trial design and setting

The long-term effects of the KNW on moderate PA and vegetable consumption were assessed by conducting a two-armed randomized controlled trial including an intervention condition (IC) and a usual care waiting list control condition (UC). After centralized registration, randomization of the participants (ratio of 1:1) was automatically performed by means of a digital randomizer at the first login to the KNW. Self-reported baseline assessment and the follow-up measurements with validated instruments after three, six, and 12 months were conducted online. In the current study, data from baseline, six, and 12-month follow-up were included into the analyses. The IC had access to the KNW throughout six months, while the UC received access to the KNW after completing the 12-month measurement. Blinding participants and researchers was not possible within this eHealth trial (Baker et al., 2010). Ethical approval for this trial (Dutch Trial Register NTR3375) was obtained from the Medical Research Ethics Committee Zuyd (NL41445.096.12, 12-T-115). After approval, the board of directors of each hospital endorsed the execution of the study.

Participants and procedure

Eligible individuals were adult (≥ 18 years of age), Dutch-speaking cancer survivors, diagnosed with various types of cancer, and who had completed primary cancer treatment (surgery, chemo- or radiation therapy) with curative intent at least four weeks, and up to 56 weeks prior to initial participation. Individuals with signs of cancer recurrence or severe medical, psychiatric, or cognitive disorders were excluded from participation.

Details of the recruitment procedures have been published elsewhere (Kanera, et al., 2016b; Willems et al., 2017a). In short, eligible cancer survivors were recruited from November 2013 through June 2014 by medical staff from 21 Dutch outpatient clinics (internal medicine, oncology, gynecology, urology, breast cancer care) during medical consultations and by reviewing patient files. A trial information package was provided, in person or by post, including comprehensive information about the trial and about scientific research (Ministerie van Volksgezondheid, 2014), an informed consent form, a short log-in instruction guide, and a storage card with contact details and personal login codes to the KNW online baseline questionnaire. One reminder letter was send after two weeks, reminding subjects to participate in the study and to return the signed informed consent form. Data from respondents who did not return the informed consent form were excluded from analysis.

Intervention

The KNW is a web-based self-management program that operates without human involvement. Comprehensive descriptions of the intervention and technical details

are published elsewhere (Kanera et al., 2016b; Willems et al., 2015). To achieve behavior change, specific determinants and behavior change methods were applied that derived from social cognitive behavior change theories and models, such as the Reasoned Action Approach (Fishbein & Ajzen, 2010), the Self-regulation Theory (Baumeister et al., 1994), and the Integrated Model for Change (I-Change Model; de Vries et al., 2003). According to these theories, health behavior change is a dynamic process with a series of awareness, behavior initiation, routinizing, and maintenance phases. This process is influenced by pre-motivational determinants (e.g., knowledge, risk perception, awareness), motivational determinants (e.g., intention, attitude, self-efficacy, social influences), and post motivational determinants (e.g., ability to prepare and execute plans to achieve goals and to overcome potential barriers; Bolman et al., 2015; de Vries et al., 2013; Sniehotta, Schwarzer, Scholz, & Schüz, 2005b). The KNW self-management modules are PA, Diet, Smoking, Return to work, Relationships, Fatigue, and Mood. The eighth module comprises generic information on the most common residual problems (Figure 6.1). After completing the baseline assessment, the IC received feedback on their reported (lifestyle) scores by comparing them with the guidelines, including advice on what KNW modules were most relevant for them to use. This module referral advice was designed as a traffic light (red, orange, green) and was aimed at consciousness raising, an effective behavior change method to change awareness and risk perception (Kok et al., 2015). When the PA and/or dietary guidelines were either not met or only partly met, respondents were advised to visit the corresponding module. Nevertheless, the respondents were free to use any module of their interest. Due to the module referral advice and the noncommittal design, it was expected that only a part of the IC participants would visit the lifestyle modules. The module-content was personalized by means of computer tailoring and customized to personal characteristics (gender, age, marital status, children, educational level, body mass index [BMI]), cancer-related issues (type of cancer, type and number of comorbidities), motivational behavioral determinants (attitude, self-efficacy and intention), and current lifestyle behavior. In addition, behavior change and self-regulation methods that are relevant in maintaining behavioral changes were applied, such as providing personalized feedback, goal setting, action- and coping planning, reattribution training, and self-monitoring. All these methods were used to improve self-efficacy and to overcome possible barriers, which is in line with social cognitive behavioral change theories (Baumeister et al., 1994; de Vries et al., 2013; de Vries et al., 2003; Kok et al., 2015).

Within the PA module, at first, detailed questions were asked concerning possible physical limitations, co-morbid conditions, and contraindications to vigorously intensive activity, as well as perceived barriers, social support, self-efficacy, and the pros and cons of being (more) physically active. This additional information was used to optimize the tailored feedback concerning the PA action- and coping planning. Action planning includes the when, where, and how of intended action. Coping planning refers to the mental simulation

of overcoming anticipated barriers to action (Sniehotta et al., 2005b). Participants were encouraged to gradually building up PA by setting achievable goals that fit with their capacities, to keep a record of the specified exercises, and to evaluate their activities. Videos of fellow cancer survivors and of specialized health professionals were enclosed to provide appropriate role models and information concerning different ways to be more active, how to cope with (physical) difficulties, how to overcome barriers, and how to attribute and cope with possible failures. For example, interpreting previous failures in terms of unstable attributions, and encouraging participants to resume engaging in their plan. This helps in maintaining behavior changes in the long term. The intervention mainly aimed at adopting and/or increasing moderate intensive activities (e.g. brisk walking, cycling, moderate sports activities, and household activities); however, if participants were interested, more vigorous sports activities were also encouraged, given that medical contraindications were excluded. Although respondents were encouraged to follow the PA recommendations, no specific prescriptions were provided concerning frequency, intensity, duration, and mode of specific exercises. The advice focused on sustainable behavior change by stimulating activities that fit optimally to individuals' capabilities and preferences.

Within the module Diet, additional questions explored cancer treatment-specific residual problems that might influence participants' dietary behavior, such as changes in taste and smell, problems with chewing and swallowing, indigestion, and undesirable weight change, pain and fatigue. Moreover, the attitude toward a healthy dietary pattern (pros and cons), perceived barriers, self-efficacy, and social support concerning a more healthy diet were measured, in order to add this information to the subsequent tailoring process. Although generic information on the comprehensive diet guidelines was provided, the module Diet focused on improving and maintaining healthy eating, particularly fruit, vegetable, whole grains, and fish consumption. After receiving personalized feedback on these dietary behaviors, participants could choose one or two pre-formulated goals concerning these four dietary behaviors, for example, "I want to eat sufficient vegetables (on average 200 g a day)". The personalized advice included relevant dietary information and support concerning coping with specific physical problems, possible difficult situations, and failure. Videos of fellow cancer survivors and specialized health professionals complemented the written advice, which was in line with the design of the PA module.

Four weeks after completing a module, participants were invited for a brief online, personalized evaluation session. After assessing whether participants (partly) succeeded or failed at changing the desired behavior, personalized feedback included advice on how to cope with success and failure aimed at increasing the level of coping self-efficacy in order to increase behavioral maintenance (Kwasnicka, Dombrowski, White, & Sniehotta, 2016). Additionally, participants were encouraged to review or adapt their action- and coping plans, in order to resume or maintain their behavior change to achieve their goals.

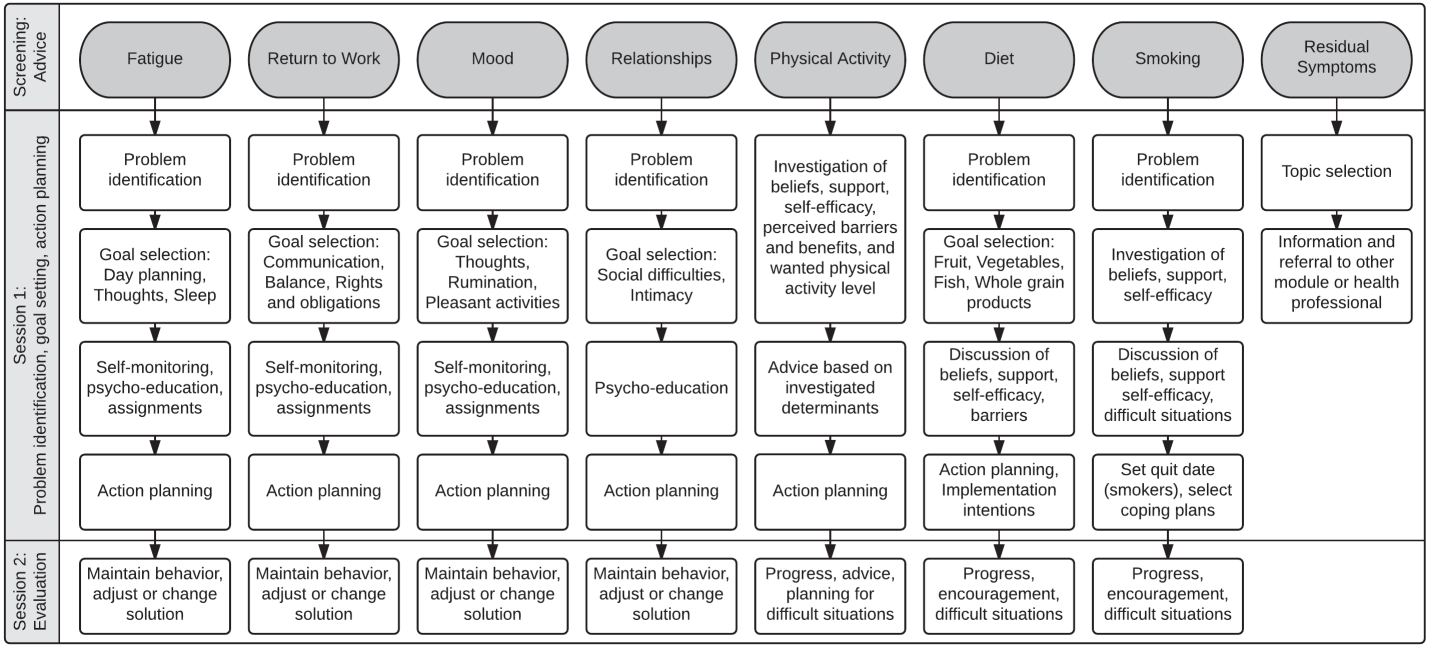
Screening: Advice
Session 1: Problem identification, goal setting, action planning
Session 2: Evaluation
Fatigue
Return to Work
Mood
Relationships
Physical Activity
Diet
Smoking
Residual Symptoms
Problem identification
Problem identification
Problem identification
Problem identification
Investigation of beliefs, support, self-efficacy, perceived barriers and benefits, and wanted physical activity level
Problem identification
Problem identification
Topic selection
Goal selection: Day planning, Thoughts, Sleep
Goal selection: Communication, Balance, Rights and obligations
Goal selection: Thoughts, Rumination, Pleasant activities
Goal selection: Social difficulties, Intimacy
Goal selection: Fruit, Vegetables, Fish, Whole grain products
Investigation of beliefs, support, self-efficacy
Information and referral to other module or health professional
Self-monitoring, psycho-education, assignments
Self-monitoring, psycho-education, assignments
Self-monitoring, psycho-education, assignments
Psycho-education
Advice based on investigated determinants
Discussion of beliefs, support, self-efficacy, barriers
Discussion of beliefs, support self-efficacy, difficult situations
Action planning
Action planning
Action planning
Action planning
Action planning
Action planning, Implementation intentions
Set quit date (smokers), select coping plans
Maintain behavior, adjust or change solution
Maintain behavior, adjust or change solution
Maintain behavior, adjust or change solution
Maintain behavior, adjust or change solution
Progress, advice, planning for difficult situations
Progress, encouragement, difficult situations
Progress, encouragement, difficult situations

Figure 6.1

Besides the tailored information within the modules, valuable generic information about psychosocial and lifestyle issues was available in the form of news items and in the user forum. Moreover, links to existing relevant websites were provided. In order to invite participants to complete questionnaires or to visit modules, several email-reminders were sent automatically with a direct link to the KNW. After the trial commencement, the intervention was applied without major adjustments, bugs, or downtimes and hyperlinks to other websites were updated when needed.

Measurements

Moderate physical activity

Moderate PA was assessed using the validated self-report Short Questionnaire to Assess Health Enhancing Physical Activity (SQUASH) at baseline, after six months, and after 12 months (de Hollander et al., 2012; Wendel-Vos et al., 2003). The 11-item SQUASH evaluates activities during commuting, leisure time, sports, household, and work. The intensity of activities was categorized into light, moderate, and vigorous. Weekly minutes of moderate PA were calculated by multiplying the number of days per week of PA with the number of minutes per day of reported moderate intensive activities. Moreover, reliability and validity of the SQUASH was confirmed in previous research among patient populations (Arends et al., 2013; Wagenmakers et al., 2008).

Vegetable consumption

In the present study, vegetable consumption was measured by assessing the number of days per week (range 0-7) of vegetable consumption and the number of vegetable servings per day (one tablespoon = 50 g). These items derived from the Dutch Standard Questionnaire on Food Consumption (van den Brink, 2005) and were used at baseline, after six months, and after 12 months. Previous research supports the reliability and validity of a similar food frequency questionnaire assessing vegetable and fruit consumption (Bogers et al., 2004). The dependent variable, vegetable consumption in grams per day (g p/d) during one week (considered as an average week), was calculated by multiplying the number of days by the amount of vegetables a day (number of tablespoons x 50 g), divided by 7 days a week.

Other relevant measures

Information about demographic and cancer-related characteristics was collected at baseline. Standard questions were used to measure age, gender, marital status, and education level. Employment status was dichotomized (*yes/no*). Type of cancer was categorized into (1) *breast,* (2) *colorectal*, and (3) *other types of cancer* (i.e., bladder, esophageal, gynecologic,

hematologic, kidney, liver, lung, prostate, stomach, testicular, and thyroid cancer). Type of treatment was categorized into (1) *surgery and chemotherapy and radiotherapy*, (2) *surgery and chemotherapy*, (3) *surgery and radiotherapy*, and (4) *other types* of treatment. Furthermore, aftercare (*yes/no*) and comorbidities (*yes/no*) were measured, and height and weight were assessed to determine BMI. The time since completion of primary treatment, measured in weeks, was based on registry data from the hospitals. Whether participants followed the modules PA and Diet was derived from program logging data. Module use was dichotomized (*yes/no*) and categorized into *yes* when at least the first three compulsory pages with important key information of the module were visited.

Sample size

Since the present study is part of a larger study project, sample size calculation was based on improvements in the main outcomes and revealed that each intervention condition needed to contain 144 participants (effect size = .30; one sided $\alpha = .05$; $\beta = 0.2$; power = .80); intra-class correlation coefficient (ICC) = 0.005). With an expected dropout of some 20%-23%, the required sample size was $N = 376$ (188 per condition) at baseline.

Statistical analysis

Baseline differences between IC and UC concerning lifestyle behaviors, and demographic and cancer-related characteristics were examined using independent t-tests and chi-square tests. Selective dropout after 12 months was assessed by applying logistic regression analysis with dropout as outcome variable (no = 0; yes = 1) and group assignment and baseline characteristics as predictive factors.

In order to evaluate the main intervention effects on moderate PA and vegetable consumption, multilevel linear regression analysis (MLA) was conducted. A three-level longitudinal data structure was used, in order to account for interdependencies. Outcomes at two time points (6 and 12-month follow-up) were clustered within the participants and participants were clustered within hospitals. Time, individuals, and hospital were added to the MLA model with a random intercept, and intervention condition and baseline value of the dependent variable were added as random slopes. The models were adjusted by adding the baseline value of the outcome behavior, standard demographic and cancer-related characteristics, significant variables from dropout analysis, and significant baseline differences. In full, the added variables were gender, age, marital status, education level, income level, employment status, BMI, type of cancer, having had cancer before, type of treatment, time since completion of primary cancer treatment, aftercare, comorbidities, vegetable intake, fruit intake, whole grain bread intake and fish intake at baseline (added as fixed intercepts). These adjustments were in line with the MLA modelling of the prior study,

conducted to determine the 6-month effects of the KNW (Kanera et al., 2016). Dummy coding was used for categorical variables including more than two categories. The models were fitted by using the maximum likelihood procedure and an independent covariance structure was chosen (Twisk, 2006). Besides complete case analysis, intention-to-treat analysis (ITT) was also conducted (Montori & Guyatt, 2001). Missing data of the 6-month and 12-month measurement were imputed 20 times, and multiple imputation analyses were conducted including all variables of the fully adjusted MLA models, as described above (Enders, 2010). Due to the use of two outcome variables, the false discovery rate correcting procedure (FDR) was applied to account for multiple testing problems (Benjamini & Yekutieli, 2001).

In order to evaluate whether module use, gender, age, and education possibly moderate the intervention effect, the fully adjusted three-level MLA model was adapted as follows: To evaluate module use as a moderator, intervention condition was categorized into three categories (*IC- module used*, *IC-module not used*, *control condition*). To explore moderating effects of gender, age, and education, interaction terms between intervention condition and gender, intervention condition and age, and intervention condition and educational level were also added to the model. The continuous variable age was centered and dummy coding was used for educational level (three categories), with educational level *low* as reference category. The moderator analyses were conducted by using the complete cases. Cohen's *d* effect sizes were calculated for the main results and the results of the moderator analysis (Cohen, 1992). Additionally, Cohen's f^2 was calculated in order to evaluate the local effect size within the context of the fully adjusted MLA model (Cohen, 1992; Selya et al., 2012). Due to differences in the datasets of the 6-month and the 12-months follow-up (due to loss to follow-up) and the three-level data structure, the outcomes of the current paper varied slightly from the corresponding outcomes after 6 months (Kanera et al., 2016). All analyses were conducted using STATA version 13.1 and the calculations of the FDR corrections were conducted in R 3.2.3., base package (R Development Core Team, 2011).

RESULTS

Study population

The flow diagram in Figure 6.2 displays the study participation of the respondents during the study period. In total, 381 (82.5%) participants filled in the 12-month follow-up questionnaire and 81 (17.5%) were lost to follow-up since baseline. Dropout after 12 months was predicted by allocation to the IC (B = 1.805, p = .000), gender (male) (B = -1.041, p = .046), (lower) high income (B = -.866, p = .047), (lower) modal income (B = -.992, p = .018), 'other' cancer treatment (B = . 959, p = .020), (less) vigorous PA at baseline (B = -.001, p = .022), (lower) vegetable intake at baseline (B = -.005, p = .031), and (higher) fruit intake at baseline (B =

.339, $p = .014$). MLA was corrected for all significant predictors of dropout. For the analyses of moderate PA, 11 respondents were excluded due to outliers (> 6720 min p/w PA) at either baseline, 6-month or 12-month follow-up, which is in accordance with the SQUASH scorings manual, resulting in a baseline dataset of $N = 451$ for analyses (Wendel-Vos & Schuit, 2004). Table 6.1 shows the demographic, cancer-related, and lifestyle-related characteristics of the participants at baseline. Mean age was 55.9 years, the majority of respondents were women (79.9%), the most represented type of cancer was breast cancer (70.6%), and more than half (53.7%) of the participants were overweight or (morbidly) obese.

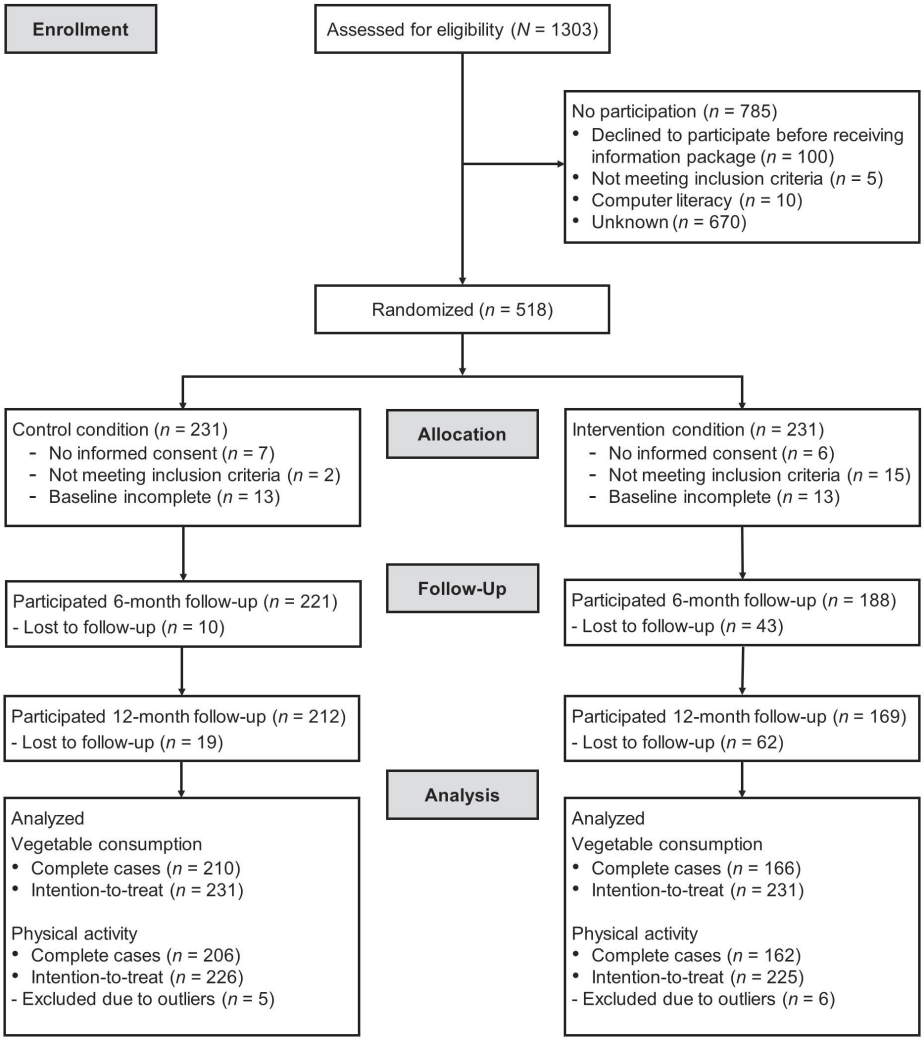

Figure 6.2 Flow diagram of participation during the study period

Table 6.1 Baseline characteristics of the KNW study sample (*N* = 462)

	Intervention group (*N* = 231)	Control group (*N* = 231)	*p*[1]
Demographic characteristics			
Female, *n* (%)	183 (79.2)	186 (80.5)	.728
Age, *M* (*SD*)	55.6 (11.5)	56.2 (11.3)	.596
Marital status, with partner[2], *n* (%)	193 (83.5)	184 (79.7)	.280
Education level[3] *n* (%)			
Low	76 (32.9)	97 (42.0)	.113
Medium	76 (32.9)	70 (30.3)	
High	79 (34.2)	64 (27.7)	
Employed, yes, *n* (%)	122 (52.8)	111 (48.1)	.306
Income below average, *n* (%)	28 (12.1)	42 (18.2)	.192
Income average, *n* (%)	84 (36.4)	78 (33.8)	
Income above average, *n* (%)	119 (51.5)	111 (48.3)	
Cancer-related characteristics			
Breast cancer, *n* (%)	162 (70.1)	164 (71.0)	.838
Other types of cancer, *n* (%)	69 (29.9)	67 (29.0)	
Treatment, *n* (%)			
Surgery, chemotherapy, radiation	86 (37.2)	108 (46.8)	.046
Surgery, chemotherapy	61 (26.4)	48 (20.8)	
Surgery, radiation	46 (19.9)	30 (13.0)	
Other	38 (16.5)	45 (19.5)	
Aftercare, yes, *n* (%)	145 (62.8)	141 (61)	.702
Number of aftercare activities, *M* (*SD*)	1.1 (1.1)	1 (1.0)	.402
Comorbidity, yes, *n* (%)	62 (26.8)	63 (27.3)	.917
Number of comorbidities, *M* (*SD*)	0.3 (0.6)	0.4 (0.7)	.600
Time since completion primary treatment (weeks), *M* (*SD*)	25.1(13.5)	23.4 (12.9)	.187
BMI, *M* (*SD*)	26.0 (5.0)	26.5 (4.9)	.295
BMI, *n* (%)			.593
<18.5, underweight	2 (0.9)	3 (1.3)	
18.5-24.9, normal weight	105 (45.5)	93 (40.3)	
25.0-29.9, overweight	90 (39.0)	96 (41.6)	
30.0-34.9, obese	24 (10.4)	32 (13.9)	
≥40, morbidly obese	10 (4.3)	7 (3.0)	
Lifestyle-related characteristics			
Physical activity, *M* (*SD*)[4]			
Weekly days > 30 min PA;	4.9 (1.9)	4.6 (2.0)	.089
Light PA min p/w	1521.5 (897.9)	1430.2 (897.7)	.281
Moderate PA min p/w	595.9 (620.5)	526.5 (546.5)	.200
Vigorous PA min p/w	231.0 (323.9)	238.0 (426.0)	.844

Table 6.1 Baseline characteristics of the KNW study sample (*N* = 462) *(Continued)*

	Intervention group (*N* = 231)	Control group (*N* = 231)	*p*[1]
Dietary behavior, *M* (*SD*)			
Vegetable intake, g p/d	138.5 (67.9)	124.2 (57.5)	.015
Fruit intake, servings p/d	1.8 (1.2)	1.6 (1.0)	.071
Whole grain bread, slices p/d	3.1 (1.8)	2.8 (1.5)	.046
Fish intake, servings per week	1.9 (1.9)	1.4 (1.3)	.001

Note: Abbreviations: BMI = Body Mass Index; *M* = mean; *SD* = standard deviation; KNW = Kanker Nazorg Wijzer

[1] p-value for dichotomous variables from chi-square test; for continuous variables independent t-test

[2] married, cohabiting partners

[3] Low: lower vocational education, medium general secondary education; Medium: secondary vocational education, higher general secondary education; High: higher vocational education, university education.

Main effects of the KNW on moderate physical activity after 12 months

The reported values in Table 6.2 are raw scores that describe the course of moderate PA at baseline, after six months, and after 12 months. The within group changes are displayed from baseline to six months (IC: *M* 150.7 min p/w; UC: *M* 72.4 min p/w) and from baseline to 12 months (IC: *M* 92.2 min p/w; UC: *M* -14.3 min p/w). After six months, the difference between IC and UC was 78.3 min p/w, and after 12 months, the between group difference was 106.5 min p/w. Table 6.3 shows the results of the MLA. The between group differences in moderate PA after 12 months were statistically significant (complete cases: *B* = 128.475, *p* = .010; ITT: *B* = 129.473, *p* = .011) with an effect size of *d* = .35; f^2= .013. Results remained significant after correction for multiple testing.

Main effects of the KNW on vegetable consumption after 12 months

The raw scores of the course of vegetable consumption at baseline, after six and 12 months are described in Table 6.2, as well as the within group changes after six months (IC: *M* 8.1 g p/d; UC: 0.7 g p/d), and after 12 months (IC: *M* -43.2 g p/d; UC: -42.8 g p/d). The between group changes were larger after six months (7.4 g p/d) compared to after 12 months (0.4 g p/d). Results from MLA revealed no significant intervention effect for vegetable consumption after 12 months (*B* = 5.860, *p* = .121; ITT: *B* = 5.560, *p* = .132). This means, that the intervention effect on vegetable consumption after six months (*B* = 11.799, *p* = .001; ITT: *B* = 11.606, *p* = .002) was not maintained (Table 6.3).

Moderating effects of module use, gender, age and education

Significant effect modification was found for age (β = -9.611, *SE* = 3.721 [95% CI = -16.90; -2.32], *p* = .010), indicating that the KNW effect on moderate PA was significantly more likely to be higher when participants were younger. Secondary analyses with a median split

Table 6.2 Observed means and standard deviations of moderate PA and vegetable intake per time point and group

	Baseline		Six months			12 months		
	N		*N*		*Change from baseline*	*N*		*Change from baseline*
Moderate PA		min p/w *M (SD)*		min p/w *M (SD)*	min p/w *M*		min p/w *M (SD)*	min p/w *M*
Intervention	225	595.9 (620.5)	178	746.6 (676.3)	150.7	162	688.1 (570.6)	92.2
Control	226	526.5 (546.5)	215	598.9 (510.7)	72.4	206	512.2 (452.1)	-14.3
Between group differences					78.3			106.5
Vegetable intake		g p/d *M (SD)*		g p/d *M (SD)*	g p/d *M*		g p/d *M (SD)*	g p/d *M*
Intervention	231	138.5 (67.9)	184	146.6 (56.0)	8.1	166	95.3 (44.7)	-43.2
Control	231	124.2 (57.5)	219	124.9 (60.8)	0.7	210	81.4 (44.1)	-42.8
Between group differences					7.4			0.4

Note: All reported values are raw. All physical activities are moderately intensive. PA = physical activity; min p/w = minutes per week; g/p/d = grams per day; *M* = mean; *SD* = standard deviation.

Table 6.3 Main intervention effects on moderate PA and vegetable consumption after 12 months. Results of multilevel analyses

	Complete cases analysis[1]						Intention-to-treat analysis[2]			
	B	*SE* [95% CI]	*p*	*p fdr*	*d* [95% CI]	f^2	*B*	*SE* [95% CI]	*p*	*p fdr*
Moderate PA (min p/w)										
After 6 months	93.707	48.058 [-.48; 187.90]	.051	.051	-.25 [-.45; -.05]	.008	92.886	49.233 [-3.82; 189.59]	.060	.060
After 12 months	128.475	49.627 [31.21; 225.74]	**.010**	**.020**	-.35 [-.55;-.14]	.013	129.473	50.393 [30.39; 228.55]	**.011**	**.022**
Vegetable intake (g p/d)										
After 6 months	11.799	3.667 [4.61; 18.99]	**.001**	**.002**	-.37 [-57; -.17]	-.013	11.606	3.781 [4.18; 19.03]	**.002**	**.004**
After 12 months	5.860	3.782 [-1.55; 13.27]	.121	.121	-.28 [-.49; -.08]	-.001	5.560	3.687 [-.67; 12.79]	.132	.132

Note: Multilevel analysis with three-level data structure (time, individuals, hospitals); *B* = Regression coefficient, *d* = Cohen's *d*, f^2= Cohen's f^2, PA = physical activity; p/w = per week, p/d = per day. Models adjusted for gender, age, marital status, education level, income level, employment, baseline BMI, cancer type, having had cancer before, treatment type, time since last treatment, participation in aftercare, comorbidities, baseline vegetable, fruit, bread, and fish consumption

[1] For physical activity outcomes *N* = 398; for diet outcomes *N* = 403

[2] Imputed data: for physical activity outcomes *N* = 451; for diet outcomes *N* = 462

(median = 57 years) confirmed this by showing that the intervention was effective among participants aged younger than 57 years after six months (B = 141.819, SE = 69.126 [95% CI = 6.34; 277.30], p = .040, d = .38, f^2 = .008) and after 12 months (B = 256.549, SE = 70.941 [95% CI = 117.51; 395.59], p = .000, d = .59, f^2 = .076), while it was not effective among participants aged 57 years and older ($B_{6\ month}$ = 38.343, SE = 65.579 [95% CI = -90.19; 166.88], p = .559; $B_{12\ month}$ = -16.047, SE = 68.337 [95% CI = -149.98; .50], p = .814). Among the younger participants, the increase in moderate PA at six months from baseline was 197.2 min p/w in the IC vs 36.1 min p/w in the UC, and after 12 months, the increase of moderate PA from baseline was 226.5 min p/w in the IC vs -49.6 in the UC (i.e. a decrease in PA). Among the older participants (≥ 57 years of age), the increase in moderate PA at six months from baseline was 102.4 min p/w in the IC vs 102.5 min p/w in the UC, and after 12 months, there was a decrease of moderate PA from baseline of -71.8 min p/w in the IC vs an increase of 33.8 min p/w in the UC. Additional tests ruled out age as a confounder.

The PA module was used by n = 46 (28.1%) of the IC participants who completed the 12-month follow-up questionnaire. Using the PA module did not moderate the intervention effect on the PA outcome after six months (β = 47.692, SE = 38.714 [95% CI = -28.19; 123.57], p = .218) and after 12 months (β = -27.736, SE = 39.302 [95% CI = -104.77; 49.29], p = .480). Furthermore, no significant moderation effects were found for gender (β = 109.065, SE = 104.309 [95% CI = -113.51; 95.38], p = .296) and education (β_{medium} = -8.275, SE = 94.673 [95% CI = -193.83; 177.28], p = .930; β_{high} = -87.163, SE = 93.508 [95% CI = -270.44; 69.11], p = .351).

DISCUSSION

The present study evaluated the 12-month effects of the web-based KNW on moderate PA and vegetable consumption. Complete cases, as well as ITT analyses, revealed that the fully automated KWN was effective in increasing and maintaining moderate PA in the long term among early cancer survivors. However, the 6-month intervention benefits on vegetable consumption did not persist in the long term.

It is very positive and promising that the effect sizes of the KNW effect on moderate PA increased over time. In contrast, Kohl et al. (2013), reported in their review of reviews of Internet-delivered behavior change interventions among the general population, that four out of six reviews on PA-only interventions showed that PA-only interventions were effective to increase PA. The reported effect sizes were modest and decreased during follow-up. The KNW effect on moderate PA was moderated by age. Respondents of the IC, aged younger than 57 years significantly increased moderate PA, while older participants (≥ 57 years) did not significantly increase moderate PA over time. The magnitude of this stratum-specific difference is of clinical importance. Higher effect sizes were found in a subgroup of participants younger than 57 years of age compared to the overall effect on moderate PA.

Overall, the long-term effect of the KNW on moderate PA was clinically relevant; with an average increase of 92.2 min p/w moderate PA in the entire IC and 226.5 min p/w among younger participants. Based on this considerable PA increase and maintenance, positive long-term health benefits may be expected, such as improvements in QoL and a reduced risk of all-cause mortality (Schmid & Leitzmann, 2014; Smits et al., 2015; Van Dijck et al., 2016; Wen et al., 2011).

Among participants of 57 years of age and older, the intervention was not effective. This is in line with findings from Niu et al. (2015), reporting that cancer survivors aged 65 years and older were less likely to meet the PA recommendations, and less likely to improve and maintain their level of PA compared with younger survivors. Age-related co-morbid conditions and physical symptoms, such as bone- or muscle loss, might impede an increase in moderate PA in older cancer survivors (Bluethmann et al., 2015; Kampshoff et al., 2016). Moreover, the web-based delivery mode and/or the content of the KNW might be more in line with relatively younger cancer survivors, who possibly better process and convert the information, with the result of higher levels of moderate PA. Possibly, cognitive skills might play a role in processing the comprehensive information supplied on the KNW portal. Recently, associations were found between age and cognitive recovery among breast cancer survivors, indicating that attention deteriorated among older survivors (≥ 60 years; Huang et al., 2016). This might indicate that the fully automated tailored support was well applicable for the younger subgroup. However, the older subgroup (in our analysis aged 57 years and older), might need different or additional support for successfully increasing moderate PA on long term.

As previously reported, there were indications that using the PA module might positively affected moderate PA outcomes after six months (Kanera et al., 2016b). However, in the present study, no significant moderation effects for use of the PA module were found at both time points. The lack of a moderation effect of module use might be explained by the small number of PA module users, which might have affected the power of analyses. Users of the PA module were encouraged to apply behavior change methods, aiming to adopt and maintain the desired amount of PA in the long term, which may have contributed to the long-term effects (Baumeister et al., 1994; de Vries et al., 2013; de Vries et al., 2003). Participants of the IC who did not use the module PA might have been triggered and encouraged to be more physically active by receiving feedback on their PA scores after completing the baseline questionnaire. Furthermore, the advantages of adopting sufficient PA in daily life were also strongly emphasized in other KNW self-management trainings modules (e.g. fatigue and mood), in the news items, and in the discussion forum.

While the KNW was beneficial in influencing vegetable consumption after six months, this positive effect was not maintained after 12 months. The lack of sustained long-term effect in vegetable consumption in the present study is in line with results of previously

evaluated web-based interventions, which aimed to improve a healthy diet among the general population (Kohl et al., 2013). Furthermore, in populations with various chronic diseases, the majority of dietary interventions reported no statistically significant effects on dietary behavior after 12 months, even when significant short-term effects were found (Desroches et al., 2013). Bluethmann et al. (2015) acknowledged that the cancer diagnosis might possibly provide a teachable moment for adopting a healthy diet, however they demonstrated that vegetable consumption continued to deteriorate as more time passes since the diagnosis. The KNW respondents started using the KNW in a period that can be considered as a teachable moment (around six months after completing primary cancer treatment). During the duration of the present study, the effect of the teachable moment may have become weaker, considering the improvements in fatigue and depressive symptoms among the IC within six months (Willems et al., 2016). This might possibly explain the overall decrease in vegetable consumption throughout the 12-month follow-up period. In sum, the vegetable consumption of the KNW users did not sustainably improve, while a healthy dietary pattern in combination with sufficient physical activity can have a positive impact on bodyweight, comorbidities, and QoL (Bruno et al., 2016; Koutoukidis et al., 2015; Tsilidis et al., 2016). To achieve sustained increases in vegetable consumption among cancer survivors, more intensive and prolonged support might be required (Christy et al., 2011; Ottenbacher et al., 2012; von Gruenigen et al., 2008).

The changes in moderate PA and vegetable consumption within the first six months of the study might be initiated by applying behavior change methods that target specific determinants that derive from social cognitive theories and behavior change models (Ajzen, 2011; Baumeister et al., 1994; de Vries et al., 2003). In their systematic review of behavior theories, Kwasnicka et al. (2016) described explanations how individuals maintain behavior changes over time, in different contexts, and including the risk of a potential lapse to the prior behavior. According the authors, relevant theoretical concepts for behavior change maintenance are maintenance motives, self-regulation, psychological and physical resources, habits, and environmental and social influences. While active self-regulation is needed to initiate behavior change, conscious self-regulation may decrease and the behavior might become more habitual and effortless with repeated performance. In the present study, different cultural and environmental influences might have influenced behavior maintenance concerning moderate PA and vegetable consumption. In the Netherlands, the level of engagement in physical activity is generally high (Loyen et al., 2016), while the consumption of vegetables in the general Dutch population is low and might be difficult to change (Geurts, Beukers, van Rossum, 2013; National Institute for Public Health and Environment, 2016).

This fully automated KNW might be appropriate to serve as a first step in a stepped care approach within cancer aftercare. Personalized broad-scoped support can be widely

disseminated at relatively low costs (Krebber et al., 2012; Ritterband & Tate, 2009). Based on the present results on moderate PA and previously published positive outcomes of the KNW on fatigue, depression, and QoL domains, the KNW seems very promising and suitable to meet a range of aftercare needs of a large group of early cancer survivors (Willems et al., 2016). Those cancer survivors who need more intensive treatment or additional support can be identified and referred to a subsequent program including more intensive assistance. Particularly, support is recommended to increase a healthy dietary pattern and to prevent a relapse of positive dietary changes. Moreover, based on our results, it should be taken into consideration that older cancer survivors might have different or additional support needs to increase moderate PA.

Even though current results derived from a strong study design, some limitations should be acknowledged. With regard to generalizability, it should be noted that the participants of the KNW did not represent the overall cancer survivor population. A large proportion of participants were middle-aged, female survivors of breast cancer with relative low levels of physical and psychological complaints and comorbidities, and already relatively active at start. The high number of breast cancer survivors might be due to the relative high prevalence of breast cancer, the good overall prognosis, and the well-organized breast cancer care in the Netherlands, which was helpful during the recruitment of study participants. Moreover, the intervention was directed to survivors who were able to get support from a web-based program. Prior findings confirm that web-based interventions generally reach more women than men (Kohl et al., 2013). Consequently, the results of our web-based intervention might not be generalizable to the overall cancer survivor population. Furthermore, the present outcomes might be affected by selective dropout. However, dropout was very low, especially for eHealth interventions (Kohl et al., 2013). Moreover, analyses were corrected for the corresponding variables and ITT analyses revealed comparable results to complete cases analyses. Another limitation might be that the outcome variables were self-reported, allowing over- and underestimation to occur due to social desirability or recall bias (van Assema et al., 2002). Misreporting of dietary intake might also be due to misrepresentation of portion sizes and daily dietary variability (Desroches et al., 2013). As previous research suggests (Vassbakk-Brovold et al., 2016), overestimation could have occurred in moderate PA, although we used a validated measurement instrument and we accounted for over-reporting (Wendel-Vos et al., 2003).

CONCLUSIONS

Access to the web-based, fully automated KNW resulted in significant positive sustained changes of moderate PA in the long term among cancer survivors younger than 57 years of age. The increase of moderate PA was clinically relevant. Relatively older cancer survivors

might, however, be in need of different or additional support in order to increase PA. Current findings that short-term increases in vegetable consumption did not sustain in the long term can be used to further improvements of the KNW. The detected low levels of vegetable intake indicate that the consumption of vegetables should be encouraged among cancer survivors, especially as more time of cancer survivorship passes. These findings add valuable information to the field, since results on long-term effects of web-based interventions on lifestyle outcomes among cancer survivors are limited. Based on these outcomes, cancer survivors can be encouraged to engage in web-based self-management interventions to increase physical activity. The KNW can complement current cancer aftercare by serving as one of the first steps in a stepped care approach.

General Discussion

7

GENERAL DISCUSSION

This thesis addressed cancer survivors' lifestyle as a part of a research project on the impact of a systematically developed web-based, evidence- and theory-grounded cancer aftercare intervention, the Cancer Aftercare Guide (Kanker Nazorg Wijzer, KNW). The main objectives were: (1) to assess the prevalence and correlates of lifestyle behaviors[1] of cancer survivors; (2) to develop lifestyle behavior change modules for former cancer patients on physical activity (PA), dietary behavior (vegetable, fruit, fish and whole grain bread consumption), and smoking, incorporated in a broader web portal; (3) to assess the use and appreciation of the KNW intervention; and (4) to evaluate the effects of the KNW intervention on lifestyle-related outcomes after six (end of portal access) and 12 months. In this general discussion section, a summary and general discussion of the main findings is provided, methodological considerations are discussed, and suggestions for future research, proposals for improvement of the intervention, and implications for implementation of the intervention into clinical practice are presented. Finally, general conclusions are provided.

SUMMARY AND DISCUSSION OF MAIN FINDINGS

Part 1. Intervention development

Prevalence and correlates of lifestyle behaviors

The cross-sectional survey in **Chapter 2** was employed to identify cancer survivors' behavioral prevalence and factors that explain engagement in these lifestyle behaviors to develop a personalized behavior change intervention. Our survey showed that a minority of cancer survivors' lifestyle behaviors was coherent with all five lifestyle recommendations. Vegetable (27.4%) and fruit (54.8%) intake were less often in accordance with the lifestyle behavior recommendations (see Box 1.1 in Chapter 1), while a majority of cancer survivors followed the recommendations concerning physical activity (PA; 87.4%), alcohol consumption (75.4%), and nonsmoking (82%; Kanera et al., 2016a). In all examined behaviors, social cognitive correlates (i.e., self-efficacy, attitude, and intention) were consistently identified as the strongest correlates, while socio-demographic, cancer-related, and other psychological factors contributed to a lower extent. Notably, the number, type, and extent of correlates that influenced the separate lifestyle behaviors varied per behavior, indicating that interventions should target the specific determinants of the five different lifestyle behaviors separately. Importantly, although the social cognitive correlates appear to be comparable to the different lifestyle behaviors, the underlying substantive content of beliefs is behavior-specific and differs; for example, self-efficacy to deal with a difficult situation for nonsmoking

1 Divers behaviors: smoking and alcohol intake, which need to be decreased, and behaviors that need to be increased as physical activity, fruit and vegetable consumption

is essentially different compared to dealing with difficult situations concerning exercising. These results emphasize that lifestyle change support should be tailored to individual lifestyle risks, to relevant personal characteristics, and particularly to relevant social cognitive factors.

Prevalence of PA

Prevalence on cancer survivors' adherence to PA recommendations vary strongly in the literature from about 18% - 50% in primarily American and British studies up to 91% in Dutch studies (Blanchard et al., 2008; Bours et al., 2015; Buffart et al., 2012; Inoue-Choi et al., 2013; Kuijpers et al., 2016; Stevinson et al., 2014; van Putten et al., 2016; Winkels et al., 2016). Differences in general are related to variations in cancer populations with regard to age and type of cancer (Fassier et al., 2016; Kang, 2015; Kuijpers et al., 2016; Winkels et al., 2016), and measurement of PA (various self-report questionnaires measuring duration and/or intensity, and accelerometers; Blanchard et al., 2008; Bours et al., 2015; Boyle, Lynch, Courneya, & Vallance, 2015b; Buffart et al., 2012; Inoue-Choi et al., 2013; Shi et al., 2017; Stevinson et al., 2014; van Putten et al., 2016). Within the Netherlands, adults aged 55-75 years report about 77% PA adherence, which is lower than among similar aged Dutch cancer survivors (Statistics Netherlands, 2015). Why Dutch cancer survivors report high levels of PA adherence requires further exploration. Both IPAQ and SQUASH ask respondents to estimate duration ánd intensity of their behavior. It might be that cancer survivors experience PA as being more heavy (higher metabolic equivalent of task [MET]) compared to peers without a history of cancer, resulting in reporting higher PA intensities and consequently a higher PA score.

Social cognitive correlates of PA

In our study and prior research among Dutch cancer survivors, associations between PA and higher self-efficacy were found (Kampshoff et al., 2016). Self-efficacy included beliefs concerning overcoming PA-related barriers such as residual problems due to cancer treatment (Kampshoff et al., 2016). A study among Canadian breast and prostate cancer survivors, employing similar theoretical foundation to our study, identified more correlates of PA, i.e., attitude, subjective norm, perceived behavior control, and intention (Blanchard, Courneya, Rodgers, & Murnaghan, 2002). In our study, cancer survivors' attitude and intention toward PA were high and consequently, for our study population there was little need to change these beliefs. It might be concluded that Dutch cancer survivors are mainly in need of advice concerning how to make chance happen; e.g., increasing self-efficacy and overcoming barriers.

Prevalence of vegetable and fruit consumption

Overall, prior (inter) national studies confirm the low prevalence (9% - 34%) of vegetable and fruit consumption among several cancer survivor populations (Blanchard et al., 2008; LeMasters et al., 2014; Winkels et al., 2016), despite differences in e.g., measurement, cancer type, and time from diagnosis. Increasing vegetable and fruit consumption should be promoted given the health benefits (e.g., reduction of fatigue, improvement of quality of life [QoL], reduced overall mortality; Emaus et al., 2016; Gong et al., 2017; Schwedhelm, Boeing, Hoffmann, Aleksandrova, & Schwingshackl, 2016; Zick et al., 2017). Adherence to the vegetable and fruit recommendation of our study population was among the middle ranking countries, which is not surprising considering the Dutch middle ranking position with regard to vegetable and fruit consumption in the general adult populations in Europe (European Food Information Council, 2012).

Social cognitive correlates of vegetable and fruit consumption

In our study, vegetable and fruit consumption were positively associated with intention only. During the social cognitive model-based statistical analysis, self-efficacy (for fruit consumption), and both self-efficacy and attitude (for vegetable consumption) contributed significantly before intention was added to the model, which is conform the Reasoned Action Approach and suggest that intention mediates the influence of attitude and self-efficacy on behavior (Fishbein & Ajzen, 2010). Our cancer survivor population did not express a need for dietary support, which created the suspicion of a potential vegetable intake misconception (Willems et al., 2016). Others studies revealed that individuals might have an unrealistic estimation (overestimation) of their personal vegetable intake (Bogers, Brug, van Assema, & Dagnelie, 2004a). To increase cancer survivors' vegetable intake they need to be made aware of their real vegetable intake first, which requires specific supportive strategies. There is a scarcity in results concerning social cognitive correlates of adherence to vegetable and fruit recommendations among Dutch cancer survivors. Nevertheless, a systematic review of social cognitive theory-based dietary behavior interventions for cancer survivors revealed that self-efficacy was associated with positive dietary changes confirming our results (Stacey et al., 2015).

Prevalence of smoking

With regard to active smoking among cancer survivors, (inter) national smoking prevalence ranges from 5% to 46%; 18% being the prevalence in our study described in Chapter 2 (Bours et al., 2015; Coups & Ostroff, 2005; Del Valle et al., 2014; Mowls et al., 2016; Thong et al., 2016; Weaver et al., 2013b; Westmaas et al., 2014). Differences in registration and regional variations might account for this variation in smoking prevalence. Moreover, also differences in cancer type and age were due to variations in smoking prevalence (Coups &

Ostroff, 2005; Westmaas et al., 2014). The proportion of smokers among our cancer survivor population is comparable to the Dutch population aged 50 - 64 (25.9%) and 65 - 75 years (16%; National Institute for Public Health and Environment, 2016b). Importantly, smoking may negatively influence cancer recurrence rates (Bishop, Killelea, Chagpar, Horowitz, & Lannin, 2014). Therefore, support in smoking cessation should be part of lifestyle promotion interventions targeting cancer survivors, a need also expressed by Dutch cancer survivors (Willems et al., 2016).

Social cognitive correlates of smoking

In Chapter 2, being a nonsmoker was correlated with higher self-efficacy, a positive attitude toward nonsmoking, lower anxiety, and better social functioning. Prior research on this topic is scarce and confirmed our findings on self-efficacy (Del Valle et al., 2014). Thus, self-efficacy to quit smoking and a positive attitude concerning nonsmoking are relevant factors that should be included in smoking cessation interventions for cancer survivors.

Prevalence of alcohol consumption

National and international adherence rates of alcohol recommendation (33% - 90%) varied to our findings (75.4%), being in the middle ranking range and in line with other Dutch studies (Bidstrup et al., 2013; Bours et al., 2015; Del Valle et al., 2014; Niu et al., 2015; Weaver et al., 2013a; Winkels et al., 2016). However, it is important to note that in our study 24.6% exceeded the alcohol recommendation, which is higher compared to another Dutch cancer survivor population (14%; Holtmaat, van der Spek, Cuijpers, Leemans, & Verdonck-de Leeuw, 2017), in the middle range compared to American cancer survivors (18% - 56%; Potash, Karnell, Christensen, Vander Weg, & Funk, 2010; Schootman et al., 2013; Weaver et al., 2013a), and higher compared to the Dutch general population aged 55-64 years (10%) and aged older than 65 years (7.4%; National Institute for Public Health and Environment, 2016a). Exceeding the alcohol recommendation was found to be associated with cancer recurrence among survivors of breast cancer (Kwan et al., 2010; McLaughlin et al., 2014; Weaver et al., 2013a). Given the relatively high proportion of excessive drinkers in our study, attention should be paid to the amount of alcohol consumed by survivors in cancer aftercare.

Social cognitive correlates of alcohol consumption

The study in Chapter 2 showed that lower self-efficacy was associated with higher alcohol consumption as confirmed by other studies (Del Valle et al., 2014). The need for assistance to reduce alcohol intake was found to be very low among Dutch cancer survivors, as reported by Willems et al. (2016). This might be a result of not wanting to be labeled as an "excessive drinker", and a low risk-perception regarding alcohol consumption and cancer recurrence, or an overestimation of a presumed anti-stress effect. The provision of adequate information

about the risk of excessive alcohol consumption and enhancing self-efficacy concerning adherence to alcohol recommendations is therefore important during cancer aftercare.

The *Kanker Nazorg Wijzer* (KNW) intervention

Addressing survivors of various cancer types and multiple behaviors is not common yet in stand-alone web-based programs for cancer survivors (Goode et al., 2015; Green et al., 2015; Kim & Park, 2015; Kuijpers et al., 2013; McAlpine et al., 2014; Post & Flanagan, 2016). To achieve the overall purpose of the KNW— increasing the QoL of cancer survivors—the intervention integrates seven lifestyle and psychosocial topics, and targets survivors of various cancer types (Willems et al., 2015). The self-management modules were PA, diet behavior, smoking cessation, coping with fatigue, return to work, anxiety and depression, and social relationships. Given this broad-scoped intervention design, tailoring was applied as a method to make the KNW personally relevant (de Vries & Brug, 1999; Noar et al., 2007). With regard to module use, following a modular sequence was not required in the KNW in contrast to other interventions (Goode et al., 2015). So, one or more desired modules could be selected and completed within one single session, or in several sessions, depending on participants' preference. Further, participants could decide for themselves which part of a module was relevant to them personally. The modules are deliberately designed this way, which might have been beneficial for intervention outcomes and for preventing attrition (Brouwer et al., 2010; Schulz et al., 2012). Low use and (very) high attrition rates (discontinuing use) were observed in other web-based interventions among the general population that include several modules about one topic that needed to be followed sequentially within several weeks (Eysenbach, 2005; Kohl et al., 2013; Peels et al., 2013b). A strength in the process of intervention development was that the lifestyle modules were aimed at promoting healthy behaviors by changing behavioral determinants that were identified during the needs assessment and based on social cognitive and self-regulation theory (Baumeister et al., 1994; de Vries et al., 2003; Fishbein & Ajzen, 2010; Kok et al., 2015). It is known from prior research that social cognitive theory-based PA and/or diet change interventions can improve lifestyle behaviors in cancer survivors (Stacey et al., 2015). The systematic development of the web-based KNW intervention was guided by the Intervention Mapping protocol and based on a needs and risk assessment, a literature review, six focus group interviews and a cross-sectional survey (Kanera et al., 2016a; Willems et al., 2016).

The fact that cancer survivors might have an unrealistic view about meeting lifestyle recommendations (Hawkins et al., 2015; Niu et al., 2015), as assumed for vegetable consumption in the discussion about our cross-sectional study, required development of an awareness-enhancing strategy: the "Module Referral Advice (MRA)". The MRA was developed to make cancer survivors aware of their lifestyle behaviors and to indicate

whether they negatively deviate from lifestyle recommendations, followed by a referral to the relevant module(s). This MRA might have led to a feeling of discomfort (in case of red or orange "traffic light"), which might have increased the likelihood of module use (Kanera et al., 2016c). More details are discussed later in this chapter (Part 2). Moreover, instruction videos and videos of fellow cancer survivors and health professionals are integrated into the modules and news items. These videos substituted an element of personal contact by expressing empathy and creating feelings of relatedness that may increase participants' intrinsic motivation and intervention involvement (Walthouwer et al., 2015c). Finally, mail messages were used to alert participants to the modules (variable frequency) and news items (six weekly) were provided including videos of professionals who discussed relevant cancer aftercare issues.

Part 2. Intervention process evaluation

Findings on intervention use among those participants who had access to the web-based KNW for six months showed that participants used most of the recommended modules **(Chapter 4).** The MRA recommendations *(M* = 2.9 modules) corresponded closely to module use (*M* = 2.1 modules; Kanera et al., 2016c). Importantly, the likelihood of using modules was higher when the MRA referred to the modules. Module users were those with the highest numbers of risks and needs, implying that the MRA was able to effectively direct participants to relevant content, in particular those with a greater range of needs. This is in line with the intended inner workings of the intervention. Additionally, survivors with higher reported needs are in general more inclined to use a larger part of an intervention (Berry et al., 2015; Borosund et al., 2013). Vice versa, module use not based on referral or perceived need was very uncommon among the KNW participants. Lower module use despite referral might have several reasons, for instance that the portal slips one's mind. This issue needs further exploration. We may conclude that our KNW users have retrieved their most relevant information from the tailored intervention. The KNW allowed self-selection regarding the modules and other intervention elements to increase perceived personal relevance, which was associated with a higher appreciation.

Module use varied from 58% to 10% of participants. Notably, the highest use concerns the module Diet, which fits with the lowest initial adherence rate to diet recommendations among the respondents (Kanera et al., 2016a). High Diet module use is striking, since no need for such advice was mentioned during the needs assessment (Willems et. al., 2016). This, again, suggests that the MRA made respondents aware of their risks successfully, which emphasizes the relevance of the strategy of creating awareness and cue to action in the context of behavior initiation and change (Bolman et al., 2015; de Vries et al., 2013; Peels, 2014). Cancer survivors with a "red" MRA were less likely to use module Diet compared to those receiving an "orange" MRA (Kanera et al., 2016c). The red MRA might have been too

much deviating from their own perceptions, since our previous findings (Willems et al., 2016) indicated no need for diet advice, possibly causing cognitive dissonance (Festinger, 1957). As a consequence, participants with a red MRA may have reduced this dissonance between their own unhealthy diet and the recommendations by changing one's perception and attitudes concerning (the importance of) a healthy diet or the credibility of the MRA instead of trying to change the unhealthy behavior.

These outcomes confirm that the intervention fit well with the needs of early cancer survivors and that the tailoring (including the MRA) worked well. Even non-module users highly appreciated the intervention, possibly due to the provision of the MRA and other intervention elements, such as the news items and the user forum. The news items included videos of various health professionals discussing various cancer aftercare topics. Unfortunately, the use of the news items and the forum was not evaluated in detail, which might be a subject of further research.

Part 3. Intervention effect evaluation

In **Chapter 5** and **6,** we assessed whether the web-based KNW was effective in changing lifestyle behaviors in the short and long term. After six months, higher increases in moderate PA and vegetable consumption with small effect sizes (moderate PA: d = .25; vegetable consumption: d = .37) were found for the KNW. These effects did not remain significant after correction for multiple testing (for the other lifestyle behaviors) that might have been analyzed as too conservative (Type 2 error; Kanera et al., 2016b). In Chapter 6, we evaluated whether the initial increases in moderate PA and vegetable intake were sustained after 12 months. As a result, a significant and clinically relevant intervention effect was observed for moderate PA among cancer survivors younger than 57 years of age with a medium effect size (d = .59). Age was identified as the only moderator of the effect on moderate PA in Chapter 6 (Kanera et al., 2017).

The 6-month increases in vegetable consumption were not sustained after 12 months. No significant main intervention effects were found for fruit, whole grain bread, and fish intake between groups, although there was some room for improvement. The lack of effect in these diet behaviors might be related, for example, to taste and regional traditions. In general, diet behavior is influenced by taste perception, and survivors might favor foods other than recommended in the KNW (Loper, La Sala, Dotson, & Steinle, 2015). According to breast cancer survivors, food choices can be related to cancer treatment issues and psychosocial distress (e.g., changes in taste, food cravings, and emotional distress; Vance, Campbell, McCargar, Mourtzakis, & Hanning, 2017). Similarly, no intervention effect was found on smoking cessation, probably due to a low number of smokers and a related power problem. Noteworthy, the likelihood of quitting was almost three times higher in the IC compared to the UC (Kanera et al., 2016b).

Use of the behavior-specific module (respectively PA – Diet) was not significantly related to increases in moderate PA and diet behavior. The behavioral changes may be caused by a combined usage of KNW elements (i.e., MRA, other modules, news items, and forum), which might have led to synergistic, mutually reinforcing effects. Which of the KNW elements may have facilitated the positive changes in moderate PA and diet behavior is not yet clear. To gain further insights into the relationships of different usage patterns with outcomes, additional analyses are required.

We provide two possible explanations for the initial increase and subsequent lack of sustained effect on vegetable consumption. First, the moment of cancer diagnosis is often considered a teachable moment. Prior studies confirmed that early cancer survivors were more likely to meet the vegetable and fruit recommendations as compared to long-term survivors (Bluethmann et al., 2015; LeMasters et al., 2014). This might explain the increase in vegetable consumption in both the intervention group and control group after six months. Besides, access to the KNW could have had an additional effect on vegetable consumption in the intervention group. However, given the decrease of vegetable consumption after 12 months in both study groups, this "teachable moment-effect" appeared to fade over time. This might imply that the KNW was not sufficiently powerful to maintain the positive changes in vegetable consumption in the intervention group in the long-term.

Second, maintaining diet change is difficult. The complexity of vegetable consumption consists of a set of many separate behaviors, for example, buying, preparing, and eating (different types of) vegetables (Bogers et al., 2004a). When healthy diet behavior has been adopted, it could become increasingly effortful for individuals to maintain self-regulation strategies aimed at maintenance of several behaviors related to vegetable consumption, besides coping with various tempting situations (Kwasnicka et al., 2016). According to the Self-regulation Theory, willpower and self-control include conscious self-regulation that is dependent upon restricted mental resources that can become depleted (Baumeister et al., 1994). Directly after receiving the MRA, participants' intention to eat more vegetables might be influenced by conscious deliberation. Optimally, the new behavior should become more automatic and the need for conscious self-regulation should therefore decrease over time, which is less energy consuming. Apparently, a higher vegetable consumption has not become a new habit among KNW participants after 12 months, suggesting that barriers (e.g., lack of willpower, lack of time to prepare healthy foods, unhealthy dietary habits of partners, and costs of and difficulty accessing healthy food) outweighed motivation, as observed by Coa et al. (2015).

A direct comparison with similar programs tested in a RCT is not possible. Some studies are ongoing or in the pilot testing stage (De Cocker et al., 2015; Krebs et al., 2017; Lee et al., 2014). "Comparable" interventions by for instance Bantum et al. (2014) and Mc Carrol et al. (2015) including in-person contact and targeting lifestyle and/or psychosocial issues,

did not report short- or long-term effects on lifestyle behaviors that were the scope in our study. We may conclude that multiple behavior web-based cancer aftercare is still in its infancy and needs further investigation (Post & Flanagan, 2016).
Besides web-based interventions, also telephone-based interventions were developed that target lifestyle among cancer survivors (Goode et al., 2015). Particularly telephone-delivered programs including intensive in-person contact were able to achieve post-intervention effects on PA and diet behavior with effect sizes ranging from low to high. All PA and diet outcomes in long-term had small to very small effect sizes ($d \leq .49$) that mostly decreased between the end of intervention and long-term follow-ups. Strikingly, the KNW revealed comparable effect sizes on moderate PA with an increase over time (among survivors younger than 57 years) compared to the abovementioned interventions that included in-person contact and targeted fewer behaviors. Overall, to our best knowledge, the study in Chapter 6 was the first that showed significant long-term effects on PA of a multiple behavior web-based intervention for survivors of various types of cancer.

METHODOLOGICAL CONSIDERATIONS

For the interpretation of the results, some methodological issues should be taken into consideration. Most of the methodological issues of the separate studies in this thesis are discussed in the previous chapters. The following section explores the most important methodological issues with regard to generalizability and internal validity of the effect studies and the main outcome measurements.

Study population

Sample characteristics

A strength of the main intervention study (Chapter 5 and Chapter 6) is the large study population ($N = 462$) at baseline that resulted in adequate statistical power. The initially calculated required sample size of $N = 376$ was exceeded. The sample included mainly middle-aged, female survivors of breast cancer with a good prognosis, low numbers of comorbidities, relatively low levels of physical and psychological complaints, and engagement in PA. This sample composition does not represent the overall population of early cancer survivors, which hampers generalization to the overall cancer survivor population. The representativeness of our main study population may have been largely influenced by the recruitment strategy that took place in 21 hospitals. However, this number of hospitals did not result in a representative sample of each possible cancer type conform the prevalence in the Netherlands. Cancer survivors were eligible when having no sign of cancer recurrence and a good prognosis, thereby excluding the more fatal cancer types. It is not surprising that for instance survivors of breast cancer, having a high one-year

survival rate (97%) were very well presented (The Netherlands Cancer Registry, 2016). The overrepresentation of breast cancer survivors may also result from the well-organized breast cancer care in Dutch hospitals, which could have made access to this group relatively easier. Moreover, our sample was relatively young. Younger people may be more interested in and having more computer skills to use online cancer aftercare than older survivors (Makai et al., 2014; Statistics Netherlands, 2016). Besides, more women than men participate in web-based programs (Bantum et al., 2014; Kohl et al., 2013; Owen, Bantum, Gorlick, & Stanton, 2015). Hence, the interpretation of our results cannot simply be generalized to male cancer survivors, older survivors, survivors of other types of cancer than breast cancer, and survivors with more psychosocial and lifestyle risks, including a low level of PA. Preferences of less represented groups regarding web-based interventions should be explored in future research.

Dropout

In our RCT, the dropout (missing follow-up measurements) during the study period was small, with 11.5% after six months and 17.5% after 12 months, which reinforces the internal validity of the intervention (Eysenbach, 2005). Reasons for the low dropout might be the automated e-mail and telephone reminders to fill in the measurements. Comparable low dropout rates were also found in other web-based interventions designed for cancer survivors (Bantum et al., 2014; van den Berg et al., 2015). Missing follow-up measurements within web-based interventions may also be due to factors such as spam filters and e-mail address changes (Baker et al., 2010). Unfortunately, such data was not collected in our study. Although overall dropout was low, the RCT was subject of selective dropout, which might have threatened the internal validity. In Chapters 5 and 6 was found that participants of the intervention condition were more likely to drop out after six months and after 12 months compared to the control condition. This is not uncommon in web-based lifestyle interventions (Reinwand et al., 2015a; Walthouwer et al., 2015c). Reasons for the intervention group for dropping out might be that using the intervention required time and intensive cognitive effort. Moreover, after 12 months, the intervention group had nothing more to expect and they possibly did not realize the importance of the follow-up measurement, while the control group was awaiting intervention participation after the last follow-up measurement. Besides, participants of the entire study sample were more likely to drop out when being male, having lower modal/high income, lower vegetable intake, higher fruit intake, and received other cancer treatment than surgery, chemotherapy and/or radiation therapy. In the statistical analysis was corrected for these predictors of dropout to keep the influence of selective dropout as limited as possible, and intention-to-treat analyses were conducted to verify our results.

To avoid Type 3 error (evaluating a program that has not been adequately implemented; Basch, Sliepcevich, Gold, Duncan, & Kolbe, 1985), we checked whether the modules were used. As mentioned before, the MRA was followed to a large extent. Moreover, almost all module users continued using the modules after reading the first three compulsory pages of the modules, suggesting that attrition regarding the intervention use was relatively low. Besides, also other intervention elements were used (news items, forum) that were not included in the referral algorithm.

Accessibility of the KNW

An important strength of the KNW is that it is accessible to cancer survivors with different personal and cancer-related characteristics such as levels of education, gender, type of cancer, and cancer treatment. Importantly, the educational level of the participants (i.e., low, medium, and high) was evenly distributed and seemed unrelated to effects, use, appreciation, and perceived personal relevance of the KNW. Accordingly, the intervention is usable, appreciated, and effective among a diverse audience.

Study design

A RCT was conducted to identify effects of the KNW on lifestyle behaviors, which was an important strength of the studies (Chapter 5 and Chapter 6). This study design, consisting of an intervention condition and a usual care waiting list control group was ethically the most appropriate to investigate the main effects of the novel and comprehensive intervention (Cunningham, Kypri, & McCambridge, 2013). The two-armed experiment entailed a valid randomization method (built-in digital randomizer) and concealment of allocation sequence was maintained until informed consent was obtained and revealed when participants logged in for the first time. After randomization, participants received information about the moment when they could access the program. Terminology concerning intervention- or control group was avoided. Blinding of participants and researchers to the intervention arm was not possible, which may be a limitation, although researchers could not influence the online self-reported assessments and the intervention itself. Another weakness might be that all participants potentially could have been exposed to other forms of online information (co-interventions); searching for information was not prohibited. However, the use of co-interventions was assessed and did not differ between study groups. Contamination between the two intervention conditions was unlikely, given the online and personalized protected delivery mode and the national outstretched recruitment of participants.

Measurements

During online data collection, completing the questions was mandatory and resulted in a dataset without missing data due to question skipping. This was a strength of the studies. To assess PA, we used the validated IPAQ Short (Craig et al., 2003) in Chapter 2 and the validated SQUASH (Wendel-Vos et al., 2003) in Chapter 5 and Chapter 6. Measuring the specific items on the SQUASH (an instrument collecting more details than the IPAQ Short) was necessary for generating personalized tailored advice within the intervention and to provide insight into the KNW effects on several PA outcomes, which was a strength of this thesis. Furthermore, to assess dietary behavior and smoking, relevant items of the validated Dutch Standard Questionnaire on Food Consumption for the general Dutch population (Bogers et al., 2004b; van den Brink et al., 2005) and standard questions form the Dutch Measuring Instruments for Research on Smoking and Smoking Cessation were used (Mudde et al., 2006). Smoking cessation was assessed by using the seven-day point prevalence abstinence that was reported as a stable measure to predict long-term abstinence (Hughes et al., 2003; Velicer & Prochaska, 2004). In contrast, other studies among cancer survivors evaluated only quit attempts (quit smoking at least one day within the past 12 months), which might be too tolerant to measure long-term smoking cessation (Emmons et al., 2013; Ramaswamy et al., 2016).

However, the use of self-report measures may be regarded as a limitation. Over- and underestimation might have occurred due to social desirability or recall bias, in particular on PA and diet outcomes. Prior research indicated that both of the used outcome measures on PA mostly overestimated PA compared to objective measures among the general population (IPAQ and SQUASH) and among cancer survivors (IPAQ; Lee et al., 2011; Nicolaou et al., 2016; Ruiz-Casado et al., 2016). A relatively small degree of overestimation was reported on dietary outcomes among the general population (van den Brink et al., 2005; van Lee et al., 2016). However, applying a self-administered questionnaire is the most feasible and least expensive method to assess lifestyle on a large scale, although the results may be less accurate compared to objectively observed results (Helmerhorst et al., 2012; Prince et al., 2008). Inaccuracy of instruments may have had an influence on the provided feedback (MRA) concerning the respondents' level of PA and diet behavior in comparison to the norms (Chapter 4). Importantly, since possible over- or underreporting was comparably present in the entire study sample, this issue did not affect the outcomes of the effect studies when comparing relative changes over time of self-reported outcomes of the intervention and control arms (Chapter 5 and Chapter 6). Further, a limitation of this project might be that we used validated self-report questionnaires without objective validation to measure outcome behaviors (Gerritsen et al., 2015). However, objective validation of behaviors was not feasible in this large-scale research project.

Statistical analyses

An important strength of the effect studies in Chapters 5 and 6 were the statistical analyses. To increase internal validity, advanced effectiveness analyses were conducted (multilevel linear regression analyses) that controlled for the baseline value of the outcome variable, potential covariates (including participation in traditional cancer aftercare), baseline differences, predictors of dropout, time-effects, and hospital variance. By applying multilevel linear regression analysis, missing data could be handled adequately (Twisk, 2006). Nevertheless, and despite the low dropout rates, multiple imputations of missing data were conducted in order to reduce non-response bias and to increase power (Enders, Mistler, & Keller, 2016; Montori & Guyatt, 2001). On the one hand, we addressed possible multiple testing problems (elevated chance of Type 1 error) by applying the false discovery rate correcting procedure (Benjamini & Hochberg, 1995). On the other hand, this might have been too conservative.

SUGGESTIONS FOR FUTURE RESEARCH

In the context of the entire KNW project aimed at increasing QoL of cancer survivors, data on lifestyle change and coping with cancer residues were collected. In order to achieve the objectives of the present thesis, the lifestyle-related data were analyzed focusing on lifestyle intervention development, identifying the main intervention effects, and the overall use (of the modules) and appreciation of the KNW. In continuation of these studies, further research questions can be answered.

It would be valuable to investigate the extent to which the KNW intervention was able to effectively influence the targeted social cognitive variables (i.e., attitude, self-efficacy, social support, intention) and whether the changes in these variables were relevant to the intervention outcomes after six and 12 months. Besides assessing these variables as potential mediators, awareness of the healthiness of one's behavior should also be considered as a mediator, since the MRA appeared to be a possible key intervention element that aimed to target awareness. Assessing awareness should therefore be added to the mediator measurements.

Sustainable diet behavior change seems to be difficult in cancer survivors. It might be worthwhile to investigate the determinants of behavior continuation. So far, research on determinants of maintenance is evolving (Rothman, 2000; Rothman, Sheeran, & Wood, 2009). Therefore, behavioral maintenance should be the main focus of future studies with regard to lifestyle behavior change and continuation, which requires long-term access to behavior change programs and longer term follow-up measurements.

Within the overall KNW research project, the main studies were divided between the themes lifestyle (present dissertation) and psychosocial aspects of cancer aftercare (Willems,

2018). Since significant increases on QoL domains emotional and social functioning, and a reduction in depression and fatigue were observed within the intervention group after six months that remained fairly stable in long term (Willems et al., 2017a; Willems, Mesters, Lechner, Kanera, & Bolman, 2017b), it would be relevant to study how the two main themes influence each other in the main results. A recent review showed that moderate intensity exercise in particular is beneficial in reducing fatigue among cancer survivors, which in turn has a positive effect on QoL (Dennett et al., 2016). Hence, we expect that our revealed increase in moderate PA might boost QoL for early cancer survivors.

Moreover, it is considered relevant to gain further insights into the quantitative and qualitative aspects related to the process of engagement in the KNW. For instance, log data could be used to analyze possible usage patterns of individuals and subgroups. Moreover, qualitative data could be collected on whether non-adherence with the MRA was a result of a conscious choice of the participants or was caused by other reasons. In addition, reasons for not accessing the KNW website at all could be an issue for further qualitative exploration. In addition, quantitative exploration of eligible cancer survivors that never logged in to the KNW is possible as well. Characteristics such as gender, age, type of cancer, type of treatment, and the termination date of primary cancer treatment were registered for all approached cancer survivors during recruitment. Based on those data, characteristics may be identified to predict the initial use of the KNW that might reveal valuable insights about the target group of the KNW. This information might be beneficial for decision-making concerning the approaching of future cancer survivors to participate in the intervention.

As discussed in Chapter 4, the associations between the MRA and module use must be interpreted with caution, since there was no intervention group using modules while not receiving the MRA. Future experimental research might explore the specific added effect of an automated referral system (such as the MRA) on subsequent choices and possible behavioral effects.

In addition, since no advanced statistical assessment of smoking was possible due to a low number of smokers and a related power problem, research on a possible KNW effect on smoking should be conducted in a sample with smokers exclusively.

PROPOSALS FOR IMPROVEMENT OF THE INTERVENTION

First, if the KNW would be implemented into practice, the intervention must be kept up-to-date, regarding the content and technical features. Recently, the Dutch diet and PA recommendations were revised, which means that KNW elements that are based on these recommendations need to be modified; e.g., the recommended amount of daily vegetable intake was increased from 200 g to 250 g; to the recommended weekly amount of 150 min PA, strength exercises (two times per week) were added. Moreover, hyperlinks that

are included to other websites should be checked regularly and updated when necessary. Second, it is advisable to involve the target group in improving the intervention in order to optimally meet their specific needs. This refers to all the following suggestions for improvements.

It is vital to keep up with website updates and developments (e.g., new trends in design, technology, tools). For instance, the attractiveness of the module buttons might be improved in a future version of the KNW. Moreover, a direct link to the module could be additionally placed in the animation of the relevant MRA (Figure 7.1).

Figure 7.1 Current design of the KNW

Furthermore, in the current KNW version, a short written prescription of the module content is provided on the first page of a module. As an additional "appetizer", relevant quotes or brief videos of previous module users might be added to this first page to provide insight into the experiences of fellow cancer survivors with the module. This might increase interest and motivation to follow the module.

Regarding the lifestyle modules specifically, some adaptations might lead to program improvements. The lifestyle module set-up was structured in a linear way. Certain choices inhibited other pathways within the lifestyle modules. The future KNW version should incorporate more flexibility to profit even more from the lifestyle modules.

Furthermore, additional news items might be developed and added that provide information on different topics, such as information about possible beneficial effects of a

healthy lifestyle on, for example, residual symptoms or side effects of hormone therapy (Lammerink, de Bock, Schroder, & Mourits, 2012).
Overall, the KNW contains a high amount of written text that might be exhausting for cancer survivors who often report suffering from concentration problems. When developing a future KNW version, the amount of written information should be evaluated critically and could possibly be replaced by attractive and empathic videos.
In addition, digital technologies continue to evolve and become more popular, especially those technologies utilizing smartphones. Incorporating mobile health (mHealth) technologies show promise in supporting people to attain health care goals and maintain healthy behaviors (Castano, Stockwell, & Malbon, 2013). Acceptance of using mobile technology and beneficial effects on lifestyle were indicated among individuals aged over 50, among individuals with a chronic illness, and among the general population (Doumit et al., 2016; Mercer et al., 2016; Wang et al., 2015). In the Netherlands, smartphone use increased considerably from 56.5% in 2012 to 84.6% in 2016 in the total population, and from 9.8% in 2016 to 50.9% among the elderly aged 65 years or older (Statistics Netherlands, 2016). These developments offer opportunities to improve the KNW by adding mobile technology (e.g., apps including wearables) that may increase intervention use and may support behavior change and behavior maintenance.

IMPLICATIONS FOR IMPLEMENTATION OF THE INTERVENTION INTO CLINICAL PRACTICE

As explored in the current thesis, various arguments advocate for implementing the KNW within Dutch cancer aftercare. The evidence- and theory-grounded, personalized, and highly appreciated online intervention fits with the risks and needs of early cancer survivors and provides easily accessible, highly structured, and comprehensive support for a large number of cancer survivors, which is lacking in current cancer aftercare in the Netherlands. Moreover, short-term benefits can be expected concerning moderate PA, diet quality (Kanera et al., 2016b), fatigue, mood, and QoL domains (Willems et al., 2017a), while long-term benefits in moderate PA are shown (Kanera et al., 2017). According to this thesis, it may be expected that particularly female, middle-aged survivors of breast cancer with all levels of education, relatively mild physical and psychosocial complaints, and a relatively good cancer prognosis might benefit most when attention would be drawn to the KNW during medical control visits. Since a growing number of cancer survivors use the Internet as a source of information, the KNW should be easy to find on the Internet, and the KNW should be presented as (part of) a trusted source. Other trusted web sources could refer to the KNW, such as www.kanker.nl, www.nfk.nl, www.kwf.nl, www.iknl.nl, hospital websites, and websites of specialized paramedics. In this way, survivors can use online cancer aftercare

support without referral. It might be expected that the number of KNW visitors would be limited without indication to it from an oncology professional. Still, a different target group might be reached, e.g., those who prefer searching for and choosing a suitable program themselves.

A higher number of survivors would be reached, when integrating the KNW in the process of setting up an individual survivorship care plan after completing primary cancer treatment, as advised in the guidelines 'Recovery from Cancer' (Comprehensive Cancer Centre the Netherlands, 2011b). First, during the consultation with an oncology professional, the KNW (i.e., online assessment and the personalized MRA) might contribute to identifying individual problem areas that may be helpful in decision-making for subsequent aftercare. Second, using the KNW content can be one of the possible aftercare options. According to the stepped-care approach, the KNW might be beneficial as web-based guided self-help, particularly for survivors with relatively mild complaints (Krebber et al., 2012). The way Dutch cancer aftercare is currently organized, cancer survivors with mild complaints usually are often excluded from support for recovery, and the KNW may fill a gap in cancer aftercare. Third, the KNW can be embedded into the general practice care. Currently, general practitioners play an increasingly important role in cancer aftercare when tasks of oncology specialists are moved to primary health care (Nederlands Huisartsen Genootschap [NHG], 2014). Fourth, the KNW can also be used alongside and in combination with the traditional face-to-face forms of aftercare, as well as in mono-disciplinary settings (e.g., oncological physiotherapy, psychological support) and interdisciplinary settings (e.g., oncological rehabilitation), since the KNW content fits with the national guidelines for oncological rehabilitation (Comprehensive Cancer Centre the Netherlands, 2011a). When embedding the KNW into the general practice and/or combining the intervention with face-to-face support, we expect to reach a broader group of cancer survivors, including survivors with different types of cancer, higher ages, higher risks and needs, and a longer time since treatment completion. Importantly, KNW effects on possible new subgroups should be evaluated.

GENERAL CONCLUSIONS

This thesis supports prior research that asserts there is a need to enhance cancer survivors' lifestyle behaviors, and that a web-based tailor-made approach may be useful to promote a healthy lifestyle. It furthermore indicates the usefulness and potential effectiveness of an online stand-alone intervention to respond to the growing demands of comprehensive and personalized cancer aftercare. The systematically developed, theory-grounded, web-based, tailored KNW intervention is aimed at supporting healthy lifestyle behaviors and psychosocial issues in order to increase survivors' QoL.

This thesis showed that participants of the KNW achieved increases in moderate PA and diet quality six months after getting access. The KNW succeeded in achieving clinically relevant increases of moderate PA after 12 months among survivors younger than 57 years of age with approximately the same effect sizes compared to interventions that included in-person support. Initially higher increases in vegetable consumption were not sustained in long term. No significant higher likelihood of smoking cessation could be proven among KNW participants, though the study provided clear indications in the positive direction. Moreover, positive changes were found in psychosocial outcomes, such as depression and fatigue, which are addressed elsewhere (Willems et al., 2017a; Willems et al., 2017b). Computer tailoring and the MRA awareness and advice tool seemed to be important key elements in the fully automated and broad-scoped KNW intervention intended to provide personal relevant support. Relevant modules were used, and the intervention was highly appreciated and perceived as personally relevant. The internal validity of the effect study was high, given the strong research design, large sample size, low dropout rates, and the advanced statistical methods used. Since middle-aged, female survivors of breast cancer with a good prognosis and relatively low levels of physical and psychosocial complaints were overrepresented in the study sample, generalization of these results to the overall cancer survivor population requires caution.

Our findings offer important new information to the research field and to clinical practice. Overall, it reveals that the fully automated KNW is accessible to a large cancer survivor audience and provides personalized, highly appreciated, and structured self-management support for a broad range of problem areas that cancer survivors face after completing primary cancer treatment. Furthermore, the KNW can be integrated into current cancer aftercare, possibly as web-based guided self-help, as it is well accepted by early cancer survivors, fits with the demands of current cancer aftercare guidelines, and requires very little time from health care providers.

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Summary

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SUMMARY

The aim of this dissertation was to develop and evaluate the web-based Cancer Aftercare Guide (Kanker Nazorg Wijzer, KNW), a fully automated and easy accessible self-management intervention that includes lifestyle as well as psychosocial topics and targets survivors of various types of cancer. A reason for developing this comprehensive eHealth intervention is the steady increase of the number of individuals who survive cancer and the need for support during recovery from cancer. Additionally, cancer survivors are at higher risk of (long-term) physical, lifestyle, and psychosocial problems, as well as of developing comorbidities and new cancers. Adopting and maintaining a healthy lifestyle, such as being physically active, consuming a healthy diet, and refraining from smoking, is highly beneficial in reducing the risk of morbidity and mortality, and to improve quality of life. However, many cancer survivors do not adhere to healthy lifestyle recommendations, and they report to be in need of support to (re)gain a healthy lifestyle balance and to manage residual psychosocial problems. Therefore, behavioral support is needed to achieve sustainable lifestyle changes and to cope with psychosocial problems.

In the Netherlands, cancer aftercare needs to be improved to offer adequate support for the growing numbers of cancer survivors, as concluded by the Health Council of the Netherlands in 2007. The subsequently developed guideline 'Recovery from Cancer' (Herstel na Kanker) pleads for a broad programmatic approach for oncology aftercare including attention for the early recognition of survivors' psychosocial and lifestyle risks and needs during early cancer survivorship. Moreover, the guideline recommends stimulation of self-management, and applying a stepped care approach as an alternative care delivery system to provide more efficient and personalized aftercare. As the Internet is increasingly used as a source of health-related information, a stand-alone theory-grounded eHealth intervention was suggested to fill this important gap in current cancer aftercare. Advantages of web-based intervention are that they are accessible anytime and anywhere and that they can reach many survivors at once without involvement of health professionals. In the Netherlands, there is a lack of comprehensive web-based cancer aftercare interventions, while those interventions might provide "guided" self-help (i.e., self-management). However, existing research into the effect and usage of multi-behavior web-based interventions for cancer survivors is very scarce. Previous studies into the effectiveness of eHealth interventions included interventions which were mostly less comprehensive, included in-person contact with a health professional, or included a relatively short follow-up period. Thus, it was considered useful to test whether a fully automated multi-behavior cancer aftercare intervention might be effective in changing lifestyle behaviors, such as physical activity, diet behavior, and smoking behavior in the short and long term. Moreover, it was considered useful to study how cancer survivors would use and appreciate a stand-alone online cancer aftercare intervention that addresses a broad range of topics.

Chapter 1 provides the background and rationale of the current thesis and highlights the importance of promoting the adoption and maintenance of healthy lifestyle behaviors among cancer survivors. Relevant determinants of lifestyle behaviors and behavior change methods are considered, and the theoretical psychosocial framework used for the studies conducted is explained. In addition, the pros and cons of applying web-based interventions targeting cancer survivors are described, and an overview of previously conducted studies evaluating web-based lifestyle interventions for cancer survivors is provided.

Chapter 2 assesses the behavioral risks of the target population related to smoking, physical activity, alcohol, and fruit and vegetable consumption. Therefore, a cross-sectional study was conducted. Relevant correlates of these different lifestyle behaviors among early cancer survivors were identified. Results showed that only a small group of cancer survivors (11%) adhered to the recommendations for all five lifestyle behaviors, and that both adherence to the recommendations for vegetable (27.4%) and fruit (54.8%) consumption was particularly low. The majority of cancer survivors followed the recommendations on physical activity (87.4%), refrained from smoking (82%), and followed the alcohol recommendations (75.4%). Each separate lifestyle behavior was influenced by different patterns of correlates, however, self-efficacy, attitude, and intention contributed to the highest extent. The insights gained from this study were valuable for the development of the intervention.

Chapter 3 describes the systematic development of the web-based computer tailored cancer aftercare intervention by using the Intervention Mapping protocol. The intervention aims to reduce cancer survivors' experienced problems in seven areas, based on the needs assessment: (1) cancer-related fatigue, (2) difficulties concerning return to work, (3) anxiety and depression, (4) relationships and intimacy issues, (5) a lack of physical activity, (6) a lack of healthy food consumption, and (7) difficulties in preparing or maintaining smoking cessation. To address these problem areas, seven self-management training modules were developed. They were based on principles of problem-solving therapy, cognitive behavioral therapy, social-cognitive, and self-regulation theories. It is expected that reducing the problems that are experienced through behavioral change will ultimately result in a higher quality of life. Since the intervention comprises a broad range of topics and targets a varied group, the content is personalized by means of computer tailoring. A personalized Module Referral Advice (MRA), based on identified risks and needs, offers guidance on which modules are most essential to use. Also, the information and advice provided within the modules is tailored to demographic, cancer-related, psychological, and motivational factors, and to the current risk behaviors and needs. Moreover, interactive features, video material, animations, and hyperlinks are included in order to substitute an element of personal contact and to support the recall of the provided information. This chapter also includes a detailed description of the study design for evaluation of this cancer aftercare intervention.

Chapter 4 describes the process evaluation of the use and appreciation of the KNW

intervention. It is investigated whether the participants allocated to the intervention followed the advice of the MRA. Moreover, the use of the modules and its predictors, the appreciation of the KNW and its predictors, and the predictors of personal relevance of the modules were identified. Almost all (98.3%) participants were referred by the MRA to at least one self-management module (*M* 2.9, *SD* 1.5), and the majority (85.7%) visited on average 2.1 (*SD* 1.6) modules. The results indicate that the MRA might be an important intervention element to guide the users to a preferred selection of modules, considering that participants were more likely to use relevant modules after a referral by the MRA. All modules were used to varying degrees, and a higher number of modules used were predicted by a higher number of risks and needs and having no partner. The overall KNW and its modules were highly appreciated, which was related to a higher perceived personal relevance. Notably, the intervention was perceived just as personally relevant by participants with different demographic and cancer-related characteristics.

Chapter 5 studied possible effects of the KNW on lifestyle behaviors (i.e., respectively vegetable, fruit, whole grain bread, and fish consumption, physical activity, and smoking behavior) six months after baseline. Therefore, a randomized controlled trial was conducted. Indications were found that participating in the intervention increased moderate physical activity and vegetable intake. A meaningful increase in moderate physical activity of 151 minutes per week was observed, which was 75 minutes per week higher compared to the control group. Moreover, using the behavior-specific modules indicated possible effects for moderate physical activity, fruit, and fish consumption. However, the results did not remain significant after correction for multiple testing and should, therefore, be interpreted with caution. No significant intervention effect was found on smoking behavior due to low numbers of smokers, although smokers in the intervention condition were almost three times more likely to quit than smokers allocated to the control condition.

Chapter 6 examined whether the positive changes in moderate physical activity and vegetable consumption determined after six months were maintained at 12 months. Additionally, possible moderator effects of using behavior-specific modules, gender, age, and education level were investigated. The results showed that the KNW was effective in increasing and maintaining moderate physical activity in the long term among early cancer survivors younger than 57 years with a moderate effect size. This effect was clinically relevant. The 6-month increases in vegetable consumption were not sustained in the long term.

Chapter 7 gives a summary and discussion of the main findings of the studies included in this thesis and discusses the methodological considerations. It offers suggestions for future research, proposals for intervention improvement, and implications for implementation of the intervention into clinical practice. Important strengths of the presented KWN intervention studies were the large study population, the strong study design (randomized

controlled trial), the follow-up period of 12 months after baseline, the low dropout rates, the advanced statistical analyses including intention-to-treat analyses, and corrections for multiple testing. There are also some limitations such as the composition of the study sample. The recommendations for future research include the investigation of the working mechanisms of the intervention, i.e., whether the effects occurred by the hypothesized changes in social cognitive factors and an expanded quantitative and qualitative evaluation related to the process of engagement in the intervention. Furthermore, future studies should focus on the determinants of behavior maintenance. Additionally, the effects of the automated referral system (MRA) could be tested more fundamentally. Importantly, after implementation of the KNW into clinical practice, the use and effects of the intervention should be followed up. In addition, a number of suggestions for improvement of the KNW are provided, including adaptations in the content and layout of the website to keep up with updates and (technical) developments. The KNW intervention can be implemented by linking the intervention to trusted websites. Moreover, the KNW can be combined with in-person guidance to address a broader group of cancer survivors.

In conclusion, indications were found that having access to the web-based KNW may increase vegetable consumption and moderate physical activity after six months, while the KNW was effective in increasing moderate physical activity among cancer survivors younger than 57 years of age at 12 months. Despite the broad scope, relevant KNW modules were used and the intervention was highly appreciated and perceived as personally relevant. The studies in this thesis indicate the usefulness and value of the KNW to respond to the growing demand of comprehensive and personalized cancer aftercare. Overall, the fully automated KNW is applicable to a large audience and provides personalized self-management support for a broad range of problem areas that cancer survivors face after completing primary cancer treatment.

Samenvatting

SAMENVATTING

Het doel van dit proefschrift was om een online zelfmanagement programma voor overlevenden van kanker te ontwikkelen en te evalueren: de Kanker Nazorg Wijzer. Dit volledig geautomatiseerde programma biedt laagdrempelige en toegankelijke ondersteuning tijdens het herstel na kanker bij het hanteren van een gezonde leefstijl als bij het omgaan met psychosociale problematiek. De aanleiding voor de ontwikkeling van deze eHealth interventie is de gestage toename van het aantal mensen dat kanker krijgt en een toenemend aantal overlevenden dat behoefte heeft aan ondersteuning bij het herstel na kanker. De gevolgen van kanker en de behandelingen liggen op verschillende levensgebieden en omvatten (langdurig aanhoudende) lichamelijke, leefstijl-gerelateerde en psychosociale problemen, evenals een hoger risico op het ontstaan van co-morbiditeit en de terugkeer van kanker. Het oppakken en volhouden van een gezonde leefstijl, zoals een gezond voedingspatroon, voldoende beweging en stoppen met roken is van groot belang om het risico op co-morbiditeit en de terugkeer van kanker te verminderen en om de kwaliteit van leven te bevorderen. Echter, de leefstijl van een groot aantal van de voormalige kankerpatiënten voldoet niet aan de geldende leefstijlaanbevelingen en er is behoefte aan ondersteuning om gezonder en actiever te leven.

In 2007 werd door de Gezondheidsraad vastgesteld dat de kankernazorg ontoereikend was om het toenemend aantal overlevenden in de herstelfase van adequate begeleiding en ondersteuning te kunnen voorzien. Recente richtlijnen benadrukken het belang van een persoonlijk relevante begeleiding met een vroege signalering van leefstijl risico's en fysieke en psychosociale problemen tijdens de herstelfase. Verder zou binnen de kankernazorg het zelfmanagement van voormalige kankerpatiënten gestimuleerd moeten worden. Om de kankernazorg efficiënt te kunnen organiseren bevelen de Gezondheidsraad en de huidige richtlijnen voor oncologische revalidatie aan om de nazorg mogelijk stapsgewijs te organiseren. Deze gefaseerde aanpak (stepped care) begint met zelfhulp (bij lichte problemen) en wordt, indien nodig, na verloop van tijd aangevuld met steeds intensievere zorg. Aangezien voor veel voormalige kankerpatiënten het Internet een belangrijke bron is van gezondheids-gerelateerde informatie, kunnen betrouwbare eHealth interventies de huidige kloof in de kankernazorg mogelijk opvullen. Voordelen van volledig geautomatiseerde eHealth interventies zijn dat zij plaats- en tijdonafhankelijk door een groot aantal personen gebruikt kunnen worden zonder de betrokkenheid van hulpverleners. Nederland heeft een gebrek aan uitgebreide en betrouwbare online kankernazorg programma's, terwijl deze efficiënte ondersteuning voor zelfhulp en zelfmanagement zouden kunnen bieden. Over het gebruik en de effectiviteit van online kankernazorg programma's, die meerdere onderwerpen omvatten, is in de huidige literatuur weinig bekend. Eerdere studies naar het gebruik en de effectiviteit van eHealth interventies in de kankernazorg omvatten programma's inclusief persoonlijk contact (met een hulpverlener),

een korte follow-up periode en minder uitgebreide programma's, bijvoorbeeld door te focussen op alleen één thema zoals bewegen. Deze programma's voorzien niet in de behoefte om zelfstandig aan meerdere probleemgebieden te kunnen werken. Daarom was in deze dissertatie een belangrijke vraag hoe voormalige kankerpatiënten een omvangrijk, volledig geautomatiseerd online kankernazorg programma zouden gebruiken en waarderen en er werd geëvalueerd of een dergelijk uitgebreid programma effectief kan zijn in het veranderen van leefstijlgedragingen zoals bewegen, voeding en roken op korte en lange termijn.

Het eerste hoofdstuk beschrijft de achtergrondinformatie en de rationale van deze dissertatie en benadrukt het belang van een gezonde leefstijl van voormalige kankerpatiënten en de bevordering ervan. Hiervoor worden relevante determinanten van leefstijlgedragingen en gedragsveranderingsmethodes beschreven en er wordt een theoretisch, psychosociaal raamwerk beschreven waarop de studies in deze dissertatie zijn gebaseerd. Daarnaast wordt ingegaan op de voor-en nadelen van eHealth interventies en een overzicht gegeven van resultaten uit eerdere studies over online leefstijl programma's voor voormalige kankerpatiënten.

In het tweede hoofdstuk worden leefstijlrisico's van overlevenden van kanker in een cross-sectionele studie geïnventariseerd in relatie tot roken, bewegen, alcohol en fruit en groenteconsumptie. Daarnaast worden relevante determinanten geïdentificeerd die met deze gedragingen samen kunnen hangen. De resultaten laten zien dat slechts weinig voormalige kankerpatiënten (11%) aan de geldende aanbevelingen voor deze vijf leefstijlgedragingen voldeed. Het aandeel voormalige kankerpatiënten dat voldoende groente (27.4%) en fruit (54.8%) consumeert was bijzonder laag. Een groot gedeelte van de deelnemers aan deze studie gaf aan voldoende te bewegen (87.4%), niet te roken (82%) en niet meer alcohol te drinken dan aanbevolen (75.4%). Verder bleek, dat elk leefstijlgedrag beïnvloed wordt door een specifiek patroon van determinanten. Echter, alle vijf leefstijlgedragingen werden het sterkst beïnvloed door de eigen-effectiviteit, de attitude en de intentie ten aanzien van het betreffende gedrag. De inzichten uit deze studie zijn verwerkt in de ontwikkeling van de Kanker Nazorg Wijzer interventie.

In het derde hoofdstuk wordt de systematische ontwikkeling van de online en "computer-tailored" Kanker Nazorg Wijzer interventie beschreven aan de hand van het Intervention Mapping protocol. De interventie is gericht op het reduceren van de problemen van voormalige kankerpatiënten ervaren. Deze zijn onder te verdelen in zeven deelgebieden: (1) kanker-gerelateerde vermoeidheid, (2) problemen met werkhervatting, (3) angst en depressie, (4) sociale relaties, intimiteit en seksualiteit, (5) voldoende lichaamsbeweging, (6) gezonde voeding, (7) stoppen met roken. Om deze probleemgebieden aan te pakken zijn zeven zelfmanagement trainingsmodules ontwikkeld. Deze modules zijn gebaseerd op de principes van problem solving therapie, cognitief-gedragsmatige therapie,

sociaal-cognitieve en zelfregulatie theorieën. De verwachting was dat de interventie zou resulteren in veranderingen in gezondheidsgedrag, waardoor de ervaren problemen zouden verminderen en de ervaren kwaliteit van leven zou toenemen. Aangezien de interventie een breed scala aan onderwerpen omvat en door een gevarieerde doelgroep kan worden gebruikt, werd de inhoud gepersonaliseerd door het toepassen van computer tailoring. De gebruikers ontvangen feedback op maat, gebaseerd op de vooraf geïnventariseerde behoeften en risico's. Dit wordt gecombineerd met een gepersonaliseerd moduleverwijssysteem, dat in de vorm van een stoplicht-kleur animatie aangeeft welke modules het meest relevant zijn om te bezoeken. Daarnaast is de inhoud van de zelfmanagement modules getailored op demografische, kanker-gerelateerde, psychologische, motivationele factoren en op de actuele gedragsrisico's. Voorts bevat de interventie interactieve functies, video materiaal, animaties en hyperlinks ter vervanging van persoonlijk contact en om de verstrekte informatie beter te kunnen onthouden. Tevens beschrijft dit hoofdstuk het onderzoeksdesign dat werd toegepast ter evaluatie van Kanker Nazorg Wijzer interventie.

Het vierde hoofdstuk bevat een procesevaluatie waarin het gebruik en de waardering van de Kanker Nazorg Wijzer wordt geëvalueerd. Er werd onderzocht of de deelnemers van de interventiegroep de gepersonaliseerde moduleaanbeveling opvolgden. Daarnaast wordt het module gebruik, de waardering en de ervaren persoonlijke relevantie van de interventie inclusief hun voorspellende factoren geïdentificeerd. Nagenoeg alle deelnemers (98.3%) werden naar minimaal één zelfmanagement module verwezen (*M* 2.9, *SD* 1.5) en de meesten (85.7%) bezochten gemiddeld 2.1 (*SD* 1.6) modules. Het module-aanbevelingsinstrument lijkt een belangrijk interventie element te zijn om de deelnemers naar de gewenste selectie van modules te leiden, aangezien de kans groter was dat deelnemers persoonlijk relevante modules gebruikten na een verwijzing naar deze modules. Alle modules werden gebruikt, echter, de mate waarin verschilde. Het gebruiken van een hoger aantal modules werd voorspeld door een hoger aantal risicofactoren, behoeften en door het niet hebben van een partner. De Kanker Nazorg Wijzer in zijn geheel en de aparte modules werden zeer positief gewaardeerd en een hogere waardering werd voorspeld door een hogere mate van waargenomen persoonlijke relevantie. Het was hierbij bijzonder opvallend dat de meeste deelnemers de interventie als even persoonlijk relevant hebben ervaren, onafhankelijk van hun demografische en kanker-gerelateerde persoonskenmerken.

Het vijfde hoofdstuk geeft een beschrijving van het onderzoek waarin de effecten zijn bestudeerd van de Kanker Nazorg Wijzer op leefstijlgedragingen zoals groente-, fruit-, volkoren brood- en visconsumptie, bewegen en het rookgedrag, zes maanden na de baselinemeting. Hierbij werd een gerandomiseerd experiment uitgevoerd. Er zijn aanwijzingen gevonden dat deelname aan de interventie de mate van matig intensief bewegen en de groenteconsumptie kan verhogen. Het aantal minuten matig intensief

bewegen nam in de interventiegroep met 151 minuten per week toe, hetgeen 75 minuten per week hoger was vergeleken met de controlegroep. Daarnaast bleek het gebruik van specifieke modules het effect op matig intensief bewegen, fruit en visconsumptie te versterken. Echter, deze resultaten verloren hun significantie na een correctie voor multiple testing en zouden daarom met voorzichtigheid geïnterpreteerd moeten worden. Er werden geen significante interventie effecten gevonden ten aanzien van het rookgedrag door een te laag aantal rokers in de studiepopulatie. Echter, rokers in de interventiegroep maakten bijna drie keer zoveel kans op stoppen met roken in vergelijking met de controlegroep.

In het zesde hoofdstuk wordt het onderzoek beschreven waarin geëvalueerd wordt of de positieve gedragsveranderingen na zes maanden op het gebied van matig intensief bewegen en groenteconsumptie op langere termijn bleven gehandhaafd (na 12 maanden). Daarnaast werden mogelijke moderatie effecten van geslacht, leeftijd, opleidingsniveau en het gebruik van de gedragsspecifieke module onderzocht. De resultaten laten zien dat de toename aan matig intensief bewegen na 12 maanden gehandhaafd bleef onder de groep van voormalige kankerpatiënten die jonger waren dan 57 jaar. Dit duurzame effect van de Kanker Nazorg Wijzer op het matig intensieve beweeggedrag had een gematigde effectgrootte en was klinisch relevant. De initiële toename van de groenteconsumptie na zes maanden bleef niet gehandhaafd na 12 maanden.

In het zevende hoofdstuk wordt een samenvatting en discussie gegeven over de belangrijkste bevindingen uit de studies die in deze dissertatie zijn beschreven en worden methodologische aspecten besproken. Daarnaast worden suggesties voor toekomstig onderzoek aangereikt en voorstellen gedaan voor een mogelijke verbetering van de Kanker Nazorg Wijzer en de implementatie in de zorgpraktijk. Belangrijke sterke punten van de gepresenteerde interventiestudies zijn de grote studiepopulatie, het sterke onderzoeksdesign (gerandomiseerd gecontroleerd experiment), de follow-up meetperiode van 12 maanden na de basislijnmeting, het lage aantal uitvallers en de geavanceerde statistische analyses inclusief intention-to-treat analyse en correcties voor multiple testing. Daarnaast worden enkele beperkingen benoemd, zoals de samenstelling van de doelgroep. Voor toekomstig onderzoek wordt aanbevolen om de werkingsmechanismen van de interventie verder te onderzoeken, door bijvoorbeeld te testen of de bereikte effecten optraden door de veronderstelde veranderingen in sociaalcognitieve factoren. Daarnaast kunnen uitgebreide kwalitatieve en kwantitatieve evaluaties plaatsvinden om het proces van inzet en betrokkenheid van de deelnemers in de interventie te verhelderen. Verder zouden toekomstige studies zich kunnen richten op de determinanten van gedragsbehoud en zouden de effecten van het geautomatiseerde moduleverwijssysteem fundamenteler kunnen worden getest. Het is belangrijk om tijdens de implementatie van de interventie in de zorgpraktijk het gebruik en de effecten van de Kanker Nazorg Wijzer te blijven volgen en te evalueren. Vervolgens worden in dit zevende hoofdstuk een aantal

aanbevelingen ter verbetering van de Kanker Nazorg Wijzer beschreven, waaronder het regelmatig doorvoeren van aanpassingen van de inhoud en de lay-out van de website om deze optimaal up-to-date te houden. De interventie zou geïmplementeerd kunnen worden door deze te linken aan betrouwbare websites en daarnaast kan de Kanker Nazorg Wijzer gecombineerd worden met persoonlijke begeleiding door hulpverleners om een bredere groep van voormalige kankerpatiënten te kunnen bereiken.

Concluderend kan worden gesteld dat de online Kanker Nazorg Wijzer het matig intensieve beweeggedrag en de groenteconsumptie van voormalige kankerpatiënten na zes maanden toegang kan verhogen en dat de interventie effectief is in het verhogen van het matig intensieve beweeggedrag op langere termijn (gemeten na een jaar) van voormalige kankerpatiënten die jonger zijn dan 57 jaar. Ondanks een breed scala aan onderwerpen in de Kanker Nazorg Wijzer gebruikten de deelnemers zoals bedoeld persoonlijk relevante modules en de interventie werd zeer positief gewaardeerd en persoonlijk relevant ervaren. De studies in deze dissertatie tonen aan dat de Kanker Nazorg Wijzer bruikbaar en waardevol is om op de groeiende zorgvraag voor gepersonaliseerde kankernazorg in te spelen. De volledig geautomatiseerde online interventie is laagdrempelig en toegankelijk voor een brede doelgroep en biedt zelfmanagement advies op maat op een breed scala van probleemgebieden waar voormalige kankerpatiënten na afronding van de primaire behandelingen mee kampen.

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DANKWOORD

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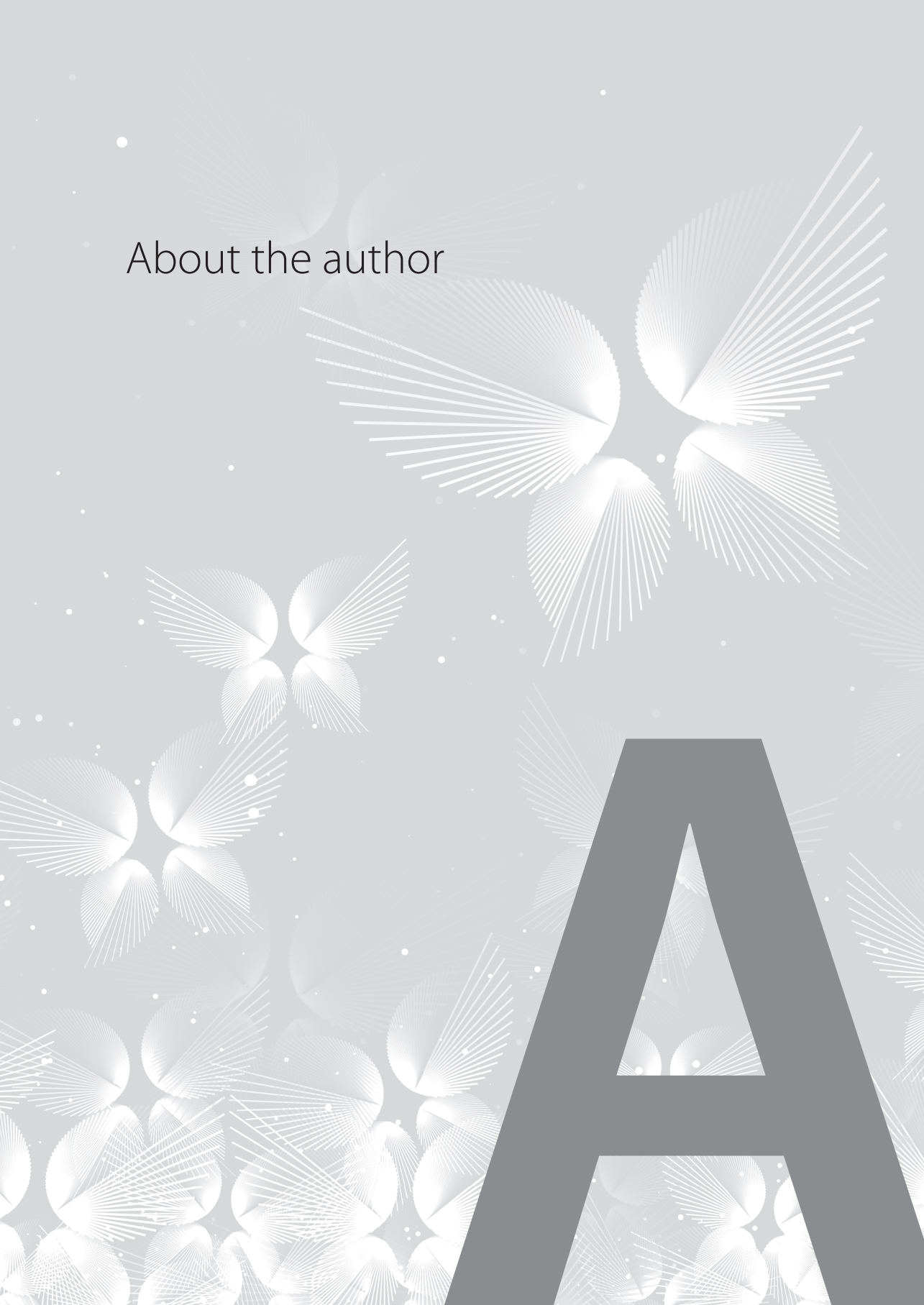
About the author



ABOUT THE AUTHOR

Born in Germany, 1971, Iris Maria Kanera attended secondary school at Gymnasium Remigianum in Borken. In 1991, she started her Sports Science study at German Sport University Cologne, later changing to study Physiotherapy at Zuyd University of Applied Science in Heerlen, the Netherlands. After graduating in 1996, she began her career as a Physiotherapist at the Adelante Rehabilitation Center in Hoensbroek, the Netherlands, and at Thuso Rehabilitation Center Maun, Botswana.

From 1997 to 2002, Iris completed a part-time Health Sciences study, with a specialization in Health Education, at Maastricht University, the Netherlands. During and after this study, she worked as a Physiotherapist at Zuyderland Medical Center and as a Health Coach at Orbis Vigor Prevention Center, both in Sittard-Geleen, the Netherlands. During this period, Iris was actively engaged in applied research projects and she was a guest lecturer for various educational institutes. Her practical experience was mainly focused on pain rehabilitation and the promotion of healthy (lifestyle) behaviors among different target groups.

In 2011, Iris continued to pursue her scientific ambitions as a Junior Researcher at the Department of Rehabilitation Medicine at Maastricht University. Her research focused on diabetes type 2 patients with painful neuropathy who experienced problems with daily life activities. The results provided important input for the rehabilitation practice and further research in this field.

In 2013, Iris started her PHD-studentship at the Department of Psychology and Educational Sciences at the Open University of the Netherlands. Together with her research team she developed and evaluated an online computer-tailored intervention for cancer survivors, the Cancer Aftercare Guide (Kanker Nazorg Wijzer). The results have been published in various international journals and presented at several national and international conferences. As a result of this successful project, the Kanker Nazorg Wijzer will now be nationally implemented by the Comprehensive Cancer Center in 2018. From autumn 2017, Iris has been directly involved in the preparations for the program implementation.

Iris is currently working as a researcher and lecturer at Zuyd University of Applied Science in Heerlen at the Research Center of Nutrition, Lifestyle, and Exercise and at the School of Physiotherapy.

List of Publications

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Journal articles

Kanera, I. M., Willems, R. A., Bolman, C. A. W., Mesters, I., Verboon, P., & Lechner, L. (2017). Long-term effects of a web-based cancer aftercare intervention on moderate physical activity and vegetable consumption among early cancer survivors: a randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1). doi: 10.1186/s12966-017-0474-2

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