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Drivers for successful long-term lifestyle change, the role of e-health: a qualitative interview study

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ABSTRACT

Objectives: In a prospective pilot study of weight loss among overweight patients, we recently found a 7.0 kg mean weight loss within a 20 months' intervention period using an online e-health approach in a general practice care setting. In order to further improve the intervention by achieving a deeper understanding of the user perspective, we conducted a qualitative interview study.
Design: Qualitative, semi-structured, individual interviews.
Setting: General practice in the Region of Southern Denmark.
Participants: Ten overweight patients who had previously used the online Internet e-health intervention.
Results: The main theme identified was a trustworthy relationship with the health professionals and/or supportive peers, friends and family. It was important to monitor the behavioural change with feedback from a trusted person, and significant life events were identified often to ignite the successful long-term lifestyle changes. The primary barriers were the perception of insurmountable obstacles, experience of lack of self-efficacy and/or excess eating of high calorie food.

Conclusion: Most important was a strong relationship with a health professional. E-health could support the relationship and provide behavioural change through monitoring and empathic relevant feedback. The support from friends and family matters, and long-term success depends on the ability to establish a strong positive support on a day-to-day basis.

Strengths and limitations of this study

- This is the first qualitative research study exploring drivers for long-term lifestyle change using an online e-health approach in general practice successfully.
- The findings of this study are relevant and generalizable to future e-health solutions.
- The main limitation of the study is the lack of methodological triangulation.

BACKGROUND

Many chronic diseases, such as diabetes, cardiovascular diseases, cancer and COPD, are caused or aggravated by common preventable risk factors, e.g. tobacco use, unhealthy diet, and physical inactivity. We found that an Internet solution could support a significant weight loss during a 20 months' period (V. Brandt et al., 2011). The solution provided various behavioural change elements as tailored information, self-monitoring, lifestyle coaching, in-person feedback, reminders, and person-to-person support. But the important drivers for such a lifestyle change and what role the Internet solution played have not previously been addressed.

Recent systematic reviews concluded that Internet and mobile interventions can improve lifestyle behaviours, and that most studies had no more than three months' follow up, and emphasized the need for long-term interventions (Afshin et al., 2016), (Hartmann‐Boyce, Johns, Jebb, & Aveyard, 2014), (Sherrington et al., 2016). Papers on practice care (PC) (Levine, Savarimuthu, Squires, Nicholson, & Jay, 2015) found that studies involving clinician-guided software or feedback from personnel appeared to promote more weight loss, but overall best practice remains undetermined especially with regard to adherence and factors important for a long-term successful lifestyle change. We therefore need to analyse how to see the patient acting "as knowing" and not "by knowing" (Storni, 2015) and acknowledge the complexities and ambivalences that are part of using self-monitoring and self-care technologies for monitoring health (Lupton, 2013).

In a prospective pilot study, we investigated the effect of interactive dietician lifestyle coaching combined with access to online person-to-person support using an existing commercial online Internet weight loss management program not using app technology [1]. We have previously described the usability of this platform and found a mean weight loss from baseline of 7.0 kg. (V. Brandt et al., 2011)

Other studies have shown similar results (Appel et al., 2011), but the results are heterogeneous (Levine et al., 2015). Teams with both medical doctors and lifestyle coaches seemed more disperse in their results averaging a little lower than teams with only lifestyle coaches. The use of behaviour change elements as self-monitoring with personnel feedback also seemed important compared to automated response feedback that only gave positive outcome in one of four studies (Levine et al., 2015). In accordance with the social cognitive theory (SCT), physical outcome expectations and proximal goal setting are important (Bandura 2004).

We therefore anticipate that the outcome expectations and goal setting need to be developed in collaboration between a coaching health professional and the patient, to have a longer lasting effect for the patient. The Internet and Facebook have changed our social patterns, and it has become possible to build relationships via digital solutions. Some studies suggest that certain groups of patients might benefit from this (Winzelberg et al., 2003).

In this paper, we report results from a qualitative interview study to identify factors of importance for weight loss management for patients who were offered the digital support system and have first hand experience in digital support and long-term successful lifestyle change. We explore: 1. What are the incitements and barriers to personal lifestyle changes in general and when using e-health solutions? 2. What is the role of peers and health professionals when changing lifestyle in general and when using e-health solutions seen from a patient perspective?

METHODS

Context

Qualitative, semi-structured, individual interviews
Setting: general practice in the Region of Southern Denmark.
Participants: ten overweight patients, three men and seven women, age 34 to 71, average age 52, with an average weight of 109 kg, who had previously been invited to use an online complex Internet e-health intervention were found by purposive sampling. They had each lost a median of 10.5 kg during the 20 months study period. Invitation was done by phone and none declined the invitation.
The intervention tool was used as a supplement to a dietician working in general practice while making sure that the relationship was established in person before beginning the online communication. The same dietician met the patient in the clinic and handled the online lifestyle coaching with the patient. Apart from the dietician, the patients could meet and share health data/information with other patients in the online forums established through the intervention tool[1]. This developed into a strong community, where it was possible for the patients also to discuss many personal issues (V. Brandt et al., 2011).

The present interviews took place 5 years after the end of the initial intervention. All patients were interviewed with for 45 min to 1 hour in their home except for two who was interviewed in the medical centre. Nobody else were present in the room of the interview during the interview. We chose a phenomenological approach in seeking to explore the experiences of participants in the long-term successful digital based intervention (V. Brandt et al., 2011). Sampling

The semi-structured interviews were segmented into four fields of interest:

1. Patient disease history,
2. Patients' experiences in taking action to change lifestyle,
3. Patients' experiences with support from health professionals and peers,
4. Patients' experiences with and thoughts about e-health solutions.

The interview guide was tested among family and colleagues prior to use. All interviews were audiotaped and performed by CJB, who is a general practitioner and has worked with

different e-health solutions for more than 15 years. Field notes were made during and right after the interviews.

Analysis

Interviews were transcribed after each interview and uploaded to a common database. Transcripts were analysed by the researchers (CJB, JC, JBN and JS) using thematic analysis and data saturation were met. The identified themes were compared between the different researchers. Overlap and consistency were reached. The findings were then related to the Social Action Theory (SAT) (Ewart, 2009), the Theory of Triadic Influence (TTI) (Flay et al., 2009) and the Social Cognitive Theory (SCT) (Bandura, 2004). Coinciding themes of importance were then put into a common framework to try to establish an understanding of the identified drivers in relation to psychosocial determinants for health behaviour.

RESULTS

All but one of the participants used smartphones or tablets. One only used a traditional cell phone and had his wife entering data via a computer. They all used apps and the Internet, but no longer had access to the intervention tool [1]. Five years after the initial intervention, they all still used the Internet or apps for benefitting their health. Everyone looked up recipes, some had joined weight loss Facebook groups, and some used an app service monitoring their physical activity. They were not aware of all the functionality that could support them for free using their smartphones, but the majority acknowledged that the provided e-health solution had helped them during the intervention period. Following the two years intervention study five years ago, some had gained weight, but not to the level before the intervention.

Table 1. Summary of main themes

Incitement/facilitators	Impediments/barriers	Role of family and friends
1.1 The trustworthy relationship to the health professional 1.2 Monitoring the behavioral change with lifestyle coaching from a referent person 1.3 Goal setting 1.4 Experiencing significant life events	2.1 The perception of insurmountable obstacles 2.2 Experience of lack of self-efficacy 2.3 Excess eating of high calorie food	3.1 Experience of honest and trustworthy person-to-person forums 3.2 Need of acknowledgement from referent others 3.3 Support from spouse/partner and family

Incitements/facilitators for lifestyle change

The establishment of an honest and trustworthy relationship to a health professional

For all successful lifestyle changes that had lasted for more than three months, the patient could refer to a person whom they trusted and who supported them in their efforts to lose weight. They all had a good and trustworthy relationship to their GPs. Six found support in the dietician involved in the study, one found support in the GP nurse, one found support in an online coach, one in a spiritual leader, and one had not been successful. The four (three men and one woman) who had not found support in the dietician in the intervention were the least successful in the study.

> ”I think it was really nice to see CA (the dietician), also because she could see it was my head that controlled me a lot”

> “I don’t know if I would always use it (the intervention tool facility to report diet intake) because sometimes I would just not report anything… avoiding being confronted with the fact that I had eaten more than I should”

Some of the patients revealed that they did not trust the dietician who had been assigned to them or the IT system, and they stated the lack of trust as the main reason for them to discontinue the intervention or to find another guidance.

> “I can’t have a settled plan… well, it is more when I told it to her then I said: “it does not work for me. I can’t use it in that way”, and then I actually did not come back….”

> “I felt the trust I had showed had been misused in a way, not that I don’t want to join a group and talk about a lot of things, what I have eaten etc….., but all of a sudden another dietician sent me messages and then I said: “now it stops, now it (the information) is so far out that I don’t want it and feel I can control it”

One of the participants established a contact to another online life style coach who helped him to achieve a significant weight loss without a single face-to-face meeting.

Monitoring the behavioural change with personnel feedback

All patients found it positive that their health professional of choice showed interest in their self-measurements.

> ”One who had to see that I kept my weight. If not, I would have said I had done it without having done it….. to satisfy others”.

> “…and I can’t cheat it (An objective activity monitoring fitness app: “Endomondo”). It is not possible for me to pretend I have gone for a walk when I haven’t”.

Goal setting

Individual goal setting was recognized as difficult. Several patients could reveal how they had daily or weekly goals for activity, diet or weight. Most effective seemed daily goals due to the fact that action was needed within small highlighted timeslots.

"Today, when I have to go to work at noon, then I would go for a walk during the morning. Sometimes I walk four times a week, but it should be at least 15 km per week."

Experienced significant perceived life events igniting the right time for action
All patients could reveal how a specific situation or life event had ignited their lifestyle change. Five revealed that a special incident in their family changed their way of thinking with regard to their lifestyle. Three had experienced that their doctor or another health professional had made it clear to them that they had to do something. Two had received an effective treatment that had helped them with their weight control or tiredness to a degree that made it possible to act in a different way.

"My husband got diabetes type 2, and then I also lost 10-12 kg in the spring…."

"It was a very specific episode that ignited it (red. the lifestyle change)… I came home one night very tired…. My husband is on his way to bed, and then he says: "by the way the kids and I found a bag of candy in your handbag that we ate - I hope that is okay?" I then went completely mad and wanted a divorce… , but then during the night, I realized that I had a problem. I had three kids, and I wanted to break up my marriage due to a bag of candy……"

Impediments/barriers to lifestyle change

The patients could reveal many reasons as to why they had difficulties keeping the weight down both from intrinsic factors within themselves and from extrinsic factors.

The perception of insurmountable obstacles
Several patients described how they used illnesses or other deficits to explain their lack of ability to do something about their health.

""Yes, if someone says: "Well, wouldn't you like to lose weight?", then I say: "Yes, but it is very hard because …. (red. I'm using antidepressants), and then the same story goes on. So it is an excuse for not losing weight"

"I had this knot under my left foot removed in surgery two years ago. Three months ago, I had the same operation in the other foot. So I'm not able to do it (exercise), and I still can't use regular foot wear. I still use sandals".

Experience of lack of self-efficacy
Several patients explained how they often felt tempted, and that their confidence in being able to avoid inappropriate behaviour was low.

"It is probably because I can eat a little candy again or buy a chocolate bar when I'm out shopping…. And I have problems saying no thanks".

Excess eating of high calorie foods
Many of the patients had experiences with the weight going up and down. When they allowed themselves to eat even small amounts of sweets, their weight went up very quickly.

> "It happened very fast. I think it was in December … I allowed myself to eat a cookie… by the end of January, I had gained 10 kg.
> "Just like an alcoholic can't drink half a bottle of wine, then I will never be able to eat 100g of chocolate without having to really holding myself back"

Role of family and friends

As severe overweight persons it is obvious to everyone they meet that they have challenges in relation to their lifestyle. The support from close family and friends was found important, and intrinsic factors that inhibit weight loss can be potentiated or challenged in contact with others.

The experience of an honest and trustworthy person-to-person forum to discuss personal challenges

Most patients found support from friends they had met in their struggle to lose weight. Both relations established in traditional meetings and online forums were described as important.

> "Then I have my friend, whom I met when I joined Weight Watchers. She has all these ideas as to how to combine different food ingredients….. and my other friend has that as well, but she has now joined this online group low fat, high something……".

> "…I'm more in need of a closed group for people who have the same problems as I have or at least are in the same position as I am" and "I could do it (be honest) if it was online, but not if I had to look them in the eyes."

Several of the patients used Facebook or apps, where they communicated with friends and family. Several of the patients described how they experienced that they were able to communicate more honestly with their online friends.

> Online: "If it is someone I would never meet, then I could be honest, but as soon I know that it is someone I am going to meet, then I add to the story".

The need for acknowledgement from referent others

To sustain a lifestyle change most of the patients said that the most important person was their partner or another person close to them who continued to regard the lifestyle change as important. For most of the patients, the dietician or another health professional had been the most important person. After the study, a number of the patients returned to their old habits, and the lack of support was missed.

> "The worst thing was that nobody called me up" and said: "Why is it you have not scheduled a new appointment?"

In the online setting, acknowledgement also made a difference to a majority of the patients using the online media.

> "I used it (red. the forum in the intervention) a lot. …the fact that I could be honest and put my cards on the table, because they all knew how it is to have the

> urge to drive to the next baker and empty the store on the way home. So it was actually very important to me that I had that forum."
>
> "….It is the same with Endomondo. I have friends there. And then I have to show I walk. Not to make them believe I'm not active"

Support from spouse/partner and family

All patients shared their goals and achievements with their spouse/partner and family. Most found their spouse/partner supportive, but a minority could also reveal how they were taking a judgmental position with regard to their lifestyle choices.

> "..when we first got started, he went all in and started to cook the way I wanted, and he also lost weight and started running."
>
> "This thing with saying: "hey we have to remember vegetables""…"He may also say: "Do you really have to eat that?" He is very observant to what I eat. A little judgmental if I eat something that is not healthy"

DISCUSSION

To our knowledge, this is the first qualitative interview study among the users of a successful long-term lifestyle change e-health platform showing what elements are important for the patient to achieve success. Establishing a trustworthy relationship with a lifestyle coach was the most important factor for a long-term successful lifestyle change. This matches the social ecological point of view that establishing a good relationship to the patient is of paramount importance for coaching patients to make difficult decisions (Bandura, 2004; Zoffmann, Harder, & Kirkevold, 2008). To establish a trustworthy relationship with your health professional can be difficult in a 100% online solution. The provided solution delivered a combination that seemed to strengthen the relationship to the lifestyle coach even though some patients were able to find a strong and consistent support by themselves outside the GP setting or in alternative settings. Goal setting and monitoring the behavioural change are important for many patients, but it needs to be delivered empathically and only when relevant. Goal-directed action is the basis of the social action theory (Ewart, 2009) and, by using e-health solutions, this can be done real time both objectively (Endomondo/accelerometers in smartphones through Google fit or Apple health kit) and subjectively through reporting. Igniting a lifestyle change was often encouraged by a specific event. This event could be intrinsic from a significant perceived life event in close family or extrinsic from a health professional who through an eye opening talk or an effective treatment helped the patient to decide that weight loss or other lifestyle changes were important enough to do something about. Barriers centred around perceived insurmountable obstacles, lack of self-efficacy, and excess eating of high calorie foods, which very much related to the intrapersonal stream described in the Theory of Triadic Influence (TTI) (Flay et al., 2009). To close the gap patients could describe how the supportive role they experienced both offline and online from referent others made a huge difference. This interpersonal aspect is the second stream in TTI and confirms that meeting others in the same situation is important. The third stream in TTI is the sociocultural environment that changes to some extent when a

person meets up online with new people who also want to lose weight. Basically, you can change your referent others ("friends") online, something that might be of paramount importance in the future, especially for people from lower social classes, with little support from home, or who live alone (Winzelberg et al., 2003). Many of the same psychological support elements are found in anonymous forums like Anonymous Alcoholics. Lastly, spouse/partner and family play an important role for our participants. The participants all reported support from their spouse/partner and family during their weight loss, which is in accordance with the social cognitive theory underlying the importance of the opinion of referent others (Bandura, 2004).
The present findings will be included in the future development of e-health solutions and tested in studies based on these new e-health solutions. (C. J. Brandt et al., 2014).

CONCLUSION

A strong relationship with a health professional or another person with coaching ability is essential for long-term successful weight loss. E-health could support the relationship and provide behavioural change through monitoring and empathic relevant feedback. The opinion of friends and family matters, and long-term success with lifestyle change depends on the ability to establish a strong positive support on a day-to-day basis, which can be supported by e-health solutions. The patient needs to feel that the health professional cares for her/him if she/he is going to experience a long-term successful lifestyle change.

Contributor statement:
CJB, JC, JBN and JS have all contributed substantialy to the conception and the design of the work, analysis and interpretation of data.
CJB, JC, JBN and JS have all been involved in drafting and revising the article critically for important intellectual content.
CJB, JC, JBN and JS have all approved the final version attached, will approve the final published version and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interest:
Carl J. Brandt owns stocks in LIVA Healthcare ApS, the company that has developed parts of the technical platform used by the patients in the pilot study.

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Data sharing statement:
All 10 interviews can be provided in Danish upon request.

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ABSTRACT

Objectives: Assisting patients in lifestyle change using collaborative e-health tools can be an efficient treatment for noncommunicable diseases like diabetes, cardiovascular disease and COPD that are caused or aggravated by unhealthy living in the form of unhealthy diet, physical inactivity or tobacco smoking. In a prospective pilot study we tested an online collaborative e-health tool in General Practice. The aim of the study was to identify drivers of importance for long-term personal lifestyle changes from a patient perspective when using a collaborative e-health tool, including the support of peers and healthcare professionals.

Setting: General practice clinics in the Region of Southern Denmark.

Participants: Ten overweight patients who had previously successfully used a hybrid online collaborative e-health tool with both face-to-face and online consultations to lose weight.

Results: The main themes identified were facilitators, barriers and support from family and peers. Establishment of a trustworthy relationship with the healthcare professionals were of paramount importance. It was important for the patients to monitor the measurable outcomes with realistic goals and feedback from a trusted person. Often, significant life events were identified as catalysts for successful long-term lifestyle changes. Dominant barriers to change were perception of insurmountable obstacles, experience of lack of self-efficacy and

excess eating of high calorie food. Finally experiencing of trustworthy person-to-person forums, need for acknowledgement from referent others and support from family and peers were important drivers for long-term lifestyle change.
Conclusion: The most important driver in long-term weight loss was a strong relationship with a healthcare professional. Collaborative e-health tools can support the relationship and behavioural changes through monitoring and relevant feedback. The support from family and peers also matters, and long-term success depends on the ability to establish strong, positive support on a day-to-day basis.

Strengths and limitations of this study

- This study identified drivers for successful long-term lifestyle change among patients having used a collaborative online e-health tool in general practice.
- This study mainly included patients with successful long-term lifestyle change, therefore reasons for lack of engagement and non-adherence might have been overseen.
- Authors CJB and JS both are General Practitioners, which might have influenced their prejudices however, all authors took this in to consideration when analysing the data.

BACKGROUND

Many noncommunicable diseases such as diabetes, cardiovascular diseases, cancer and COPD are caused or aggravated by common preventable risk factors, e.g. tobacco use, unhealthy diet, and physical inactivity. Although being overweight and having an unhealthy lifestyle can be uncomfortable, changing lifestyle is extremely difficult. For weight loss to have a positive impact on health, it needs to be sustainable and especially long-term lifestyle changes (defined as more that 12 to 18 months) have proven difficult.[1] One of the major challenges for lifestyle change seems to be that social relationships that are often challenged by peers, who do not understand the importance of the lifestyle change to the person.[2] This might be one of the reasons why patients find it difficult to acknowledge the complexities and ambivalences that are part of using collaborating e-health tools.[3]

Even though recent systematic reviews have concluded that Internet and mobile interventions can improve lifestyle behaviours, most studies had no more than three to six months' follow up, which emphasizes the need for research in long-term interventions.[4, 5, 6] Most e-health tools and electronic lifestyle monitors use behavioural change techniques such as self-monitoring, goal setting and social support.[7] In systematic reviews, adding personal feedback seems to improve outcome in comparison to automated response feedback.[8]

Several key theories of change from the field of behavioural science are employed in many lifestyle change and e-health tools, and have been used in this study as well. In accordance with social cognitive theory (SCT), a number of constructs come into play when patients try to change lifestyle. SCT has five constructs: (1) measurable outcome i.e. steps, (2) proximal goal setting i.e. daily breakfast, (3) procedural knowledge instead of content knowledge i.e. to walk 10000 steps daily instead of "live healthy", (4) perceived self-efficacy through experiences of reaching planned goals, and (5) social structural factors i.e. the influence of experiencing support (or obstruction) for a healthier lifestyle from family or peers.[9] The Social Action Theory (SAT) takes it one step further and explains how goal-directed action can lead to cognitive change that ultimately restructures the environmental context, including social relations, for long-term lifestyle change.[10] Finally, the theory of triadic influence (TTI) outlines that to be successful, three streams of information need to be recognised: the intrapersonal

stream, the interpersonal stream and the social environmental stream, indicating the complexity of helping a patient change from an unhealthy lifestyle to a healthy lifestyle.[11]

We therefore anticipate that the outcome expectations and goal setting need to be developed in collaboration between a health coaching professional and the patient in order to have a longer-lasting effect for the patient. The Internet and the rise of social media have changed our social patterns, and it has become possible to build relationships via digital tools. Some studies suggest that certain groups of patients might also benefit from this[12].

In a previous study, we found that a collaborative online e-health tool could support a significant weight loss of 7,0 kg during a 20 month period in a general practice setting. The collaborative e-health tool was used in a hybrid manner beginning with a personal meeting and included various behavioural change techniques such as joint goal setting, tailored information, self-monitoring, lifestyle coaching, in-person feedback, reminders, and person-to-person support.[13] A second version of the same collaborative e-health tool showed similar results for men with diabetes, who had an average 5,4 kg weight loss during a 12 month period (compared to 2,8 kg for a control group) in a municipal setting. Semi-structured interviews with patients in the later study suggested that the initial face-to-face meeting was important for building a trustworthy relationship.[14] But overall, the important drivers for such a lifestyle change and what role the collaborative e-health tool played has not previously been addressed.

Hence we aimed to identify drivers of importance for weight loss management for patients who had used a hybrid collaborative online e-health tool for weight loss taking into account the patient's perspectives having experienced a collaborative e-health model.

METHODS

Design

To create new knowledge about the essential themes for this group of patients we used qualitative, semi-structured, individual interviews to explore the field without distraction.

Context

Ten overweight patients from a rural area in the Region of Southern Denmark were recruited for the study. They had all participated in the previous study that utilised a hybrid collaborative online e-health tool also involving face-to-face meetings.

Sampling

Purposive sampling was conducted among patients who had participated in the prior study with regard to gender, age and weight loss. Three men and seven women, ages 34 to 71, average age 52, with an average weight of 109 kg and a median weight loss of 10.5 kg (from 2 to 16 kg) during the 20-month study period were invited. Six had been consistently interacting with the designated healthcare professional during the study, two stopped responding to information given, one left the study early and one never started. Invitations for this qualitative study were by phone and none declined the invitation.

The intervention

The collaborative online e-health tool was used as a supplemental tool for a dietician working in general practice, making sure that the relationship was established in-person before

beginning online communication. The same dietician met the patient in the clinic and handled the online lifestyle coaching with the patient. Apart from the dietician, the patients could meet and share health data/information with other patients in the online forums established through the collaborative e-health tool (Appendix 1). This developed into a strong community where it was also possible for patients to discuss many personal issues[13].

Interview Procedure

The interviews presented in this study took place 5 years after the end of the initial intervention. All patients were interviewed for 45 minutes to 1 hour and a relaxed atmosphere was achieved by holding the interviews one to one in the patients' homes, except for two who preferred to be interviewed in the medical centre. All interviews were carried out by CJB, who has worked as a GP for more than ten years and with different e-health tools for more than 15 years, including the e-health tool used in the intervention. Before every interview, CJB briefly explained the purpose and nature of the research, answered questions, and provided participants with a description of the study in layman's terms. CJB explained to the patients that the interview data would be anonymized, and an informed consent document was signed by both the patient and CJB. The ethics committee for the Region of Southern Denmark reviewed the protocol and found that the Medical Research Involving Human Subjects Act does not apply to this study. A formal approval was therefore not required for this study. We did obtain written consent nevertheless, due to the sensitivity of the subject matter.

Table 1. Interview guide

Themes	**Probing questions**
Disease history	Do you have any diseases? What does that mean to you? What does it mean for your wellbeing? How do you see your health in general?
Experience with taking action to change lifestyle	Have you ever taken the initiative to improve or change your lifestyle? How did it go?
Experience with support from health professionals and peers	Who has helped you with your health challenges? Who has been the best to help you? How? What was the worst experience? How?
Experience with and thoughts about e-health tools	Do you have a smartphone? Have you ever used apps or the Internet in relation to your health or wellbeing? Have you found recipes on the internet? Have you used apps in relation to exercise?

The semi-structured interviews followed an interview guide, which resulted in an iterative approach, for emerging themes and perspectives to be explored[15]. The semi-structured interviews were segmented into four fields of interest: 1) Patient disease history, 2) Patient experiences with taking action to change lifestyle, 3) Patient experiences with support from health professionals and peers, and 4) Patient experiences with and thoughts about e-health tools. See Table 1.

The interview guide was tested among family and colleagues prior to use. All interviews were audiotaped. Field notes were made during and immediately after the interviews.

Analysis

Interviews were transcribed and uploaded to a common database verbatim. Transcripts were analysed by the researchers (CJB, JC, JBN and JS) using thematic analysis. An explorative approach was applied for systematic text condensation.[16 17] The process began with reading the transcripts. After the initial 4 interviews, the authors conducted an overview of the transcripts and identified themes of importance. The authors then agreed on codes across ideas and themes that could be categorized. CJB then coded all transcripts in accordance with the agreed codes. The coded transcripts were shared and discussed. Data from each theme were condensed and summarized into concepts and generalized descriptions. Several times throughout the process, identified themes were compared between the different researchers. Overlap was identified and consistency was reached. Coinciding themes of importance were then put into a common framework. Data collection was terminated due to saturation when no new themes emerged. The quotes that best illustrated the different themes and subthemes were selected and translated from Danish to English by CJB. All quotes were then evaluated by the remaining authors and changes were made to reach agreement among all authors.

RESULTS

All but one of the participants used smartphones or tablets. One only used a traditional cell phone and had his wife entering data via a computer. They all used apps and the Internet, but no longer had access to the intervention tool www.slankedoktor.dk described in accordance with (TIDieR) checklist[18] and the cCALO-RE: Coventry, Aberdeen and London-Refined taxonomy[19] in Appendix 1. Five years after the initial intervention, they all still used the Internet or apps for benefitting their health. Everyone looked up recipes, some had joined weight-loss Facebook groups, and some used an app-based service monitoring their physical activity. They were not aware of all the functionality that could support them for free using their smartphones, but the majority acknowledged that the provided collaborative e-health tool had helped them during the intervention period. Following the two years' intervention study five years ago, some had gained weight, but not to the level before the intervention. We identified three main themes: facilitators, barriers, and the support of family and peers (see Table 2).

Facilitators for lifestyle change

A number of subthemes were identified to facilitate long-term lifestyle change, but over all establishing an honest relationship with a healthcare professional, who were trusted to monitor the patient and able to set realistic goals with the patient were most important

The establishment of an honest and trustworthy relationship with the health professional

For all successful lifestyle changes that had lasted for more than three months, the patient could refer to a person whom they trusted and who supported them in their efforts to lose weight. They all had a good and trustworthy relationship with their GPs. Six found support from the dietician involved in the study (including online support), one found support from the GP nurse, one found support from an online coach, one from a spiritual leader, and one

Table 2. Summary of main themes

Facilitators	**Barriers**	**Support from family and peers**
The establishment of an honest and trustworthy relationship with the health professional Monitoring the behavioural change with personal feedback Goal setting Experiencing significant life events igniting the right time for action	The perception of insurmountable obstacles Experience of lack of self-efficacy Excess eating of high calorie food	Experience of honest and trustworthy person-to-person forums Need for acknowledgement from referent others Support from family and peers

had not been successful. The four (three men and one woman) who had not found support in the dietician in the intervention were the least successful in the pilot study.[13]

> I think it was really nice to see CA (the dietician), also because she could see it was my head that controlled me a lot. (P2, female)

Some of the patients said that they did not trust the dietician who had been assigned to them nor did they trust the e-health tool, and they identified the lack of trust as the main reason for discontinuing the intervention or seeking other guidance.

> I can't have a settled plan… well, it is more when I told it to her then I said: "it does not work for me. I can't use it in that way", and then I actually did not come back…. (P5, male)

> I felt the trust I had showed had been misused in a way, not that I don't want to join a group and talk about a lot of things, what I have eaten etc….., but all of a sudden another dietician sent me messages and then I said: "now it stops, now it (the information) is off track, that I don't want it and feel I can't control it. (P9, male)

One of the participants established contact with another online lifestyle coach who helped him to achieve a significant weight loss without a single face-to-face meeting, which means

that seven out of ten had used online support for their weight loss and three had found face-to-face support from alternative sources that were better for them.

Monitoring the behavioural change with personal feedback
All patients found it positive that their health professional of choice showed interest in their self-measurements.

> One who had to see that I kept my weight. If not, I would have said I had done it without having done it….. to satisfy others…….
> …and I can't cheat it (An objective activity monitoring fitness app: "Endomondo"). It is not possible for me to pretend I have gone for a walk when I haven't. (P1, female)

Goal setting
Individual goal setting was recognized as difficult. Several patients revealed that they had daily or weekly goals for activity, diet or weight. Daily goals seemed most effective due to the fact that action was needed within small, discrete windows of time.

> Today.. I just have to walk my 10.000 steps, and swim two times a week. And then I eat what I always have eaten except I don't eat that stof (candy), because I'm not tired, so I don't need it. (P8, female)
> Then I stopped eating candy, and I have neither bought or had candy for three months and I have lost 7 kg. (P3, female)

Experienced life events perceived as significant, igniting the right time for action
All patients revealed how a specific situation or life event had ignited their lifestyle change. Five revealed that a specific incident in their family changed their way of thinking with regard to their lifestyle. Three had experienced that their doctor or another health professional had made it clear to them that they had to do something. Two had received an effective treatment that had helped them with their weight control or tiredness to a degree that made it possible to act in a different way.

> ….It was a very specific episode that ignited it (the lifestyle change)… I came home one night very tired…. My husband is on his way to bed, and then he says: "by the way the kids and I found a bag of candy in your handbag that we ate - I hope that is okay?" I then went completely mad and wanted a divorce… , but then during the night, I realized that I had a problem. I had three kids, and I wanted to break up my marriage due to a bag of candy…… (P10, female)

Barriers to lifestyle change

The patients gave many reasons as to why they had difficulties keeping the weight off, both in their own perception of insurmountable obstacles, experience of lack of self-efficacy and in having difficulties with excess eating of high calorie foods, which is explained in more detail below.

The perception of insurmountable obstacles
Several patients described how they used illnesses or other deficits to explain their lack of ability to do something about their health.

> I had this knot under my left foot removed in surgery two years ago. Three months ago, I had the same operation in the other foot. So I'm not able to do it (exercise), and I still can't use regular footwear. I still use sandals. (P1, female)

Experience of lack of self-efficacy
Several patients explained how they often felt tempted to indulge in high-calorie foods, and that their confidence in being able to avoid inappropriate behaviour was low.

> It is probably because I can eat a little candy again or buy a chocolate bar when I'm out shopping…. And I have problems saying no thanks. (P2, female)

Excess eating of high calorie foods
Many of the patients had experiences with their weight going up and down. When they allowed themselves to eat even small amounts of sweets, their weight went up very quickly.

> "It happened very fast. I think it was in December … I allowed myself to eat a cookie… by the end of January, I had gained 10 kg……Just like an alcoholic can't drink half a bottle of wine, then I will never be able to eat 100g of chocolate without having to really hold myself back. (P10, female)

Support from family and peers

As severely overweight people, it is obvious to everyone they meet that they have challenges in relation to their lifestyle. The support from close family and friends was found important, and intrinsic factors that inhibit weight loss can be potentiated or challenged when the person came into contact with other supportive individuals.

The experience of honest and trustworthy person-to-person forums
Most patients found support from friends they had met in their struggle to lose weight. Both relations established in traditional meetings and online forums were described as important.

> "Then I have my friend, whom I met when I joined Weight Watchers. She has all these ideas as to how to combine different food ingredients….. and my other friend has that as well, but she has now joined this online group low fat, high something……" (P6, female)

Several of the patients used Facebook or apps, where they communicated with friends and family. Several of the patients described how they experienced that they were able to communicate more honestly with their online friends.

> …I'm more in need of a closed group for people who have the same problems as I have or at least are in the same position as I am" and "I could do it (be honest) if it was online, but not if I had to look them in the eyes."
> "If it is someone I would never meet, then I could be honest, but as soon I know that it is someone I am going to meet, then I add to the story. (P2, female)

Need for acknowledgement from referent others
To sustain a lifestyle change, most of the patients said that the most important person was their partner/spouse or another person close to them who continued to regard the lifestyle

change as important. For most of the patients, the dietician or another healthcare professional had been the most important person. After the study, a number of the patients returned to their old habits, and the lack of support was missed.

> ”The worst thing was that nobody called me up and said: “Why is it you have not scheduled a new appointment?” (P2, female)

In the online setting, acknowledgement also made a difference to a majority of the patients.

> I used it (the forum in the intervention) a lot. …The fact that I could be honest and put my cards on the table, because they all knew how it is to have the urge to drive to the next baker and empty the store on the way home. So it was actually very important to me that I had that forum. (P10, female)

> “….It is the same with Endomondo. I have friends there. And then I have to show I walk. Not to make them believe I’m not active. (P7, female)

Support from family and peers

All patients shared their goals and achievements with their family. Most found their family supportive, but a minority also revealed that the partner/spouse took a judgmental position with regard to their lifestyle choices and some tried to support their partner/spouse through loving teasing.

> ..Before I lost weight my breathing was really bad … and I couldn’t sleep at night so I would fall asleep during the day… then I would be reviled by N (partner): “Now you are sitting falling asleep again” I could in a chair and fall asleep. (P4, male)

DISCUSSION

We aimed to identify important drivers for long-term lifestyle change for patients using a hybrid collaborative e-health tool and found that establishing a trustworthy relationship with a healthcare professional doing lifestyle coaching was the most important factor for a long-term successful lifestyle change. This matches the social ecological point of view that establishing a good relationship with the patient is of paramount importance for coaching patients to make difficult decisions[9 20 21]. To establish a trustworthy relationship with a healthcare professional can be difficult in a fully online e-health tool. The provided e-health tool in this study utilised a hybrid model, both in-person and online, that seemed to strengthen the relationship with the healthcare professional even though some patients found strong and consistent support by themselves outside the GP setting or in alternative settings. The main reasons for non-adherence was lack of trust in the dietician, and lack of trust in the e-health tool, which is in line with other studies examining reasons for noncompliance with e-health tools[22].

Goal setting and monitoring the behavioural change are important for many patients, but it needs to be delivered empathically and only when relevant. Goal-directed action is the basis of the social action theory[10] and, by using e-health tools, this can be done real-time both

objectively (via accelerometers in smartphones, using apps such as Google Fit, Apple's built-in Health app, or Endomondo) and subjectively through reporting. Lifestyle changes were often ignited by a specific event. This event could be intrinsic, from a perceived significant life event for the individuals or their close family, or extrinsic, such as an eye-opening talk with a health professional or an effective treatment that helped the patient decide that weight loss or other lifestyle changes were important enough to make a change.

Barriers centred around perceived insurmountable obstacles, lack of self-efficacy, and excess eating of high calorie foods, which very much related to the intrapersonal stream described in the Theory of Triadic Influence (TTI)[11]. To close the gap and reach their goals despite these barriers, patients described how the support they experienced both offline and online from referent others made a huge difference. This interpersonal aspect is the second stream in TTI and confirms that meeting others in the same situation is important.

The third stream in TTI is the sociocultural environment that changes to some extent when a person meets new people (including online) who also want to lose weight. That is, you can change your referent others ("friends") online, something that might be of paramount importance in the future, especially for people from lower social classes, with little support from home, or who live alone[12]. Many of the same psychological support elements via change of reference others are found in other successful lifestyle change groups such as Alcoholics Anonymous and/or Overeaters Anonymous. Lastly, family and peers play an important role for our participants. The participants all reported support from their family as important during their weight loss, which is in accordance with the social cognitive theory underlying the importance of the opinion of referent others [9].

Strengths and limitations of this study

This is the first qualitative research study exploring drivers for successful long-term lifestyle change using a collaborative online e-health approach in general practice. The digital revolution makes it difficult to detect general principles for successful e-health tools before they are out-dated; instead, this qualitative study explores themes of importance across various persuasive technologies and collaborative e-health platforms that could not be highlighted in a quantitative study. It is a potential weakness that we do not know if our sample was more technically savvy than the average population, which should be addressed in future studies. On the other hand the access to new technologies becomes easier all the time why we believe the principles outlined in this applies study to most patients.

This study mainly included patients with successful long-term lifestyle change, meaning reasons for lack of engagement and non-adherence might have been overseen.

The study did not look at perspectives of individuals in relation to their outcomes; with more individuals and methodological triangulation, this might have revealed the quantitative importance of the identified themes. The result of this study is probably generalizable and supports the notion that the implementation of collaborative e-health tools might have the potential to change patient lifestyles via low-cost support for healthy living. The preconception of the authors' CJB and JS, who are GPs, might have compromised the objectivity of the data in interviews and analysis, even though it was taken into account in the analysis. Future research needs to examine the perspectives of GPs and healthcare professionals who assist patients using collaborative e-health tools, in order to better understand the perspectives of all stakeholders.

CONCLUSION

A strong relationship with a healthcare professional or another person with coaching ability is essential for long-term successful weight loss when using e-health tools. The collaborative e-health tool can be viewed as a supplement to the professional empathic relationship and support behavioural change through monitoring and empathic, relevant feedback. The opinions of family and peers matter. Long-term success with lifestyle change depends on the ability to establish strong positive support on a day-to-day basis, which can be supported by e-health tools. The patient needs to feel that the healthcare professional cares for her/him if she/he is going to be successful with a long-term lifestyle change. The present findings are probably generalizable to the use of collaborative e-health tools and have formed the basis of the later development of a collaborative e-health tool using focus group interviews in a 'thinking aloud' protocol where the patients and healthcare professionals interact with the app and the backend control panel,[23] that is going to be used in a future study.[24]

Contributor statement:
CJB, JC, JBN and JS have all contributed substantially to the conception and the design of the work, analysis and interpretation of data.
CJB, JC, JBN and JS have all been involved in drafting and revising the article critically for important intellectual content.
CJB, JC, JBN and JS have all approved the final version attached, will approve the final published version and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interest:
Carl J. Brandt owns stock in LIVA Healthcare ApS, the company that has developed parts of the technical platform used by the patients in the pilot study.

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Data sharing statement:
All 10 interviews can be provided in Danish upon request.

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Appendix 1. (TIDieR) checklist[a] for the former Slankedoktor.dk - A web-based weight loss intervention

TiDieR checklist item	Description
What Online weight loss coaching by dietician and exercise coach	The dietician, who initially met the participating patient face-to- face in the doctor´s office, also provided online lifestyle coaching using the interactive web-based weight loss program. To gain access to the e-health tool, the patient had to fill out a comprehensive document online covering his/her medical history, health status, educational level and medicine intake, and accept the sharing of data between the dietician, the doctor and an exercise coach. When consent was given, the patient had access to scheduled web-based consultations and dialog with the dietician and exercise coach through embedded email-style messages sent within the website, an online community "Forum for Debate", and an embedded e-mail chat that connected the patient with other patients participating in the study and with private users, who had purchased access to the service to lose weight in a non-clinical setting. The system was set up to notify the user when new feedback was available and the users could also communicate with other users using functions like comments on entries of food and physical activity inputs and personal pictures. To kick off the initial weight loss period lasting approximately four months, a personal diet plan and exercise plan, based on the first week of day-to-day online registrations of weight measurements, meals and physical activity, was provided to the patient. The subsequent online consultations with the dietician took place weekly. The content of these consultations was at the professional discretion of the health professionals, but overall the focus was on the patient's registrations and questions, information in relation to the patient's weight status and recommendations on how to perform specific behaviours and set new goals. The exercise coach could be consulted online every fourth week in the first four months. If deemed necessary by the dietician, a patient could see the dietician face-to-face in the doctor's office in between the scheduled online consultations, within the first two to three months of the study period. Overall, face-to-face consultations in the doctor's office with the dietician were planned to take place every third and sixth month. Included BCT[b] from the CALO-RE taxonomy[c] (hereafter referred to as BCT): provide feedback on performance; provide instruction on how to perform the behaviour; provide information on consequences of the behaviour in *general* and *to the individual*; goal setting: behaviour and outcome; action planning; barrier identification/problem solving; relapse prevention and coping planning; prompt practice; plan social support/social change) The inputs described underneath this column are available to the patient and are an important part of the intervention. The patients can keep record of specified behaviour(s) on a daily, weekly or monthly basis. If the patients make their registrations daily, it becomes possible for both the health professionals and the patient to follow progress or setbacks closely, as the numbers and registrations are visualized with graphs and curves. (BCT: goal setting: behaviour and outcome; prompt self-monitoring of behaviour; provide feedback on performance; prompt practice)
Daily food intake input	Reporting of daily food intake: type of foods, amounts and time consumed can be compared to the personal diet plan. This makes it possible to advise and support the patient in getting a more balanced diet, e.g. eating smaller meals throughout the day, getting more vegetables and fruit, less carbs, fat and sugar and choosing whole-grain options when possible. (BCT: provide feedback on performance; prompt self-monitoring of behaviour)

My healthy cookbook	The patients can access and share recipes and links to websites with healthy cooking instructions among each other, the feature is supervised by the dietician on request. (BCT: prompt practice; facilitate social comparison)
Physical activity input	Recording of type, time and intensity of any physical activity. The patients are taught how to set realistic goals and receive advice on different activities and how to implement them in daily life. They also learn how to convert activity into calories burnt, to get a better understanding of the balance between energy intake and energy output. (BCT: provide instruction on how to perform the behaviour; prompting generalization of a target behaviour; relapse prevention/coping planning)
Weight measurements input	Recording of current weight and goal weight, and reporting of waist measurements to display progress. The patients are instructed on how to do the measurements at the same time and in the same way every day. (BCT: prompt self-monitoring of behaviour and behavioural outcomes; provide feedback on performance)
Forum for debate	Online community for users with a weight problem. The forum made it possible to exchange knowledge, gain social support from peers and build new relationships. The health professionals could also give advice to the forum users and encourage them to contact each other for support (BCT: planning social support/social change)
Who provided	Professional dietician and exercise coach
How	Individually delivered via the e-health tool
Where	Initial face-to-face meetings between the participating patient, their personal doctor and the dietician in the doctor's office. Then mainly web-based delivery.
When and how much	The initial face-to-face consultation with the dietician lasted approx. 45-60 minutes. Thereafter, in a four to six-month period, asynchronous web-based consultations were carried out once weekly with the dietician and every fourth week with the exercise coach. Thereafter (maintenance period), it was possible for both the patient and the dietician to request web-based consultations, typically monthly. (BCT: use of follow up prompts)
Tailoring	Every participating patient received personalized web-based consultations from their designated dietician and exercise coach based on the patient's own inputs online.
Modifications	Only minor modifications were made during the study.

[a] Based on Hoffmann et al 2014 [18]
[b]BCT: behaviour change techniques.
[c]CALO-RE: Coventry, Aberdeen and London-Refined taxonomy[19]

Appendix 1. (TIDieR) checklist[a] for the former Slankedoktor.dk - A web-based weight loss intervention

TiDieR checklist item	Description
What	The dietician, who initially met the participating patient face-to- face in the doctor´s office, also provided online lifestyle coaching using the interactive web-based weight loss program. To gain access to the e-health tool, the patient had to fill out a comprehensive document online covering his/her medical history, health status, educational level and medicine intake, and accept the sharing of data between the dietician, the doctor and an exercise coach. When consent was given, the patient had access to scheduled web-based consultations and dialog with the dietician and exercise coach through embedded email-style messages sent within the website, an online community "Forum for Debate", and an embedded e-mail chat that connected the patient with other patients participating in the study and with private users, who had purchased access to the service to lose weight in a non-clinical setting. The system was set up to notify the user when new feedback was available and the users could also communicate with other users using functions like comments on entries of food and physical activity inputs and personal pictures. To kick off the initial weight loss period lasting approximately four months, a personal diet plan and exercise plan, based on the first week of day-to-day online registrations of weight measurements, meals and physical activity, was provided to the patient. The subsequent online consultations with the dietician took place weekly. The content of these consultations was at the professional discretion of the health professionals, but overall the focus was on the patient's registrations and questions, information in relation to the patient's weight status and recommendations on how to perform specific behaviours and set new goals. The exercise coach could be consulted online every fourth week in the first four months. If deemed necessary by the dietician, a patient could see the dietician face-to-face in the doctor's office in between the scheduled online consultations, within the first two to three months of the study period. Overall, face-to-face consultations in the doctor's office with the dietician were planned to take place every third and sixth month. Included BCT[b] from the CALO-RE taxonomy[c] (hereafter referred to as BCT): provide feedback on performance; provide instruction on how to perform the behaviour; provide information on consequences of the behaviour in *general* and *to the individual*; goal setting: behaviour and outcome; action planning; barrier identification/problem solving; relapse prevention and coping planning; prompt practice; plan social support/social change) The inputs described underneath this column are available to the patient and are an important part of the intervention. The patients can keep record of specified behaviour(s) on a daily, weekly or monthly basis. If the patients make their registrations daily, it becomes possible for both the health professionals and the patient to follow progress or setbacks closely, as the numbers and registrations are visualized with graphs and curves. (BCT: goal setting: behaviour and outcome; prompt self-monitoring of behaviour; provide feedback on performance; prompt practice)
Online weight loss coaching by dietician and exercise coach	
Daily food intake input	Reporting of daily food intake: type of foods, amounts and time consumed can be compared to the personal diet plan. This makes it possible to advise and support the patient in getting a more balanced diet, e.g. eating smaller meals throughout the day, getting more vegetables and fruit, less carbs, fat and sugar and choosing whole-grain options when possible. (BCT: provide feedback on performance; prompt self-monitoring of behaviour)

My healthy cookbook	The patients can access and share recipes and links to websites with healthy cooking instructions among each other, the feature is supervised by the dietician on request. (BCT: prompt practice; facilitate social comparison)
Physical activity input	Recording of type, time and intensity of any physical activity. The patients are taught how to set realistic goals and receive advice on different activities and how to implement them in daily life. They also learn how to convert activity into calories burnt, to get a better understanding of the balance between energy intake and energy output. (BCT: provide instruction on how to perform the behaviour; prompting generalization of a target behaviour; relapse prevention/coping planning)
Weight measurements input	Recording of current weight and goal weight, and reporting of waist measurements to display progress. The patients are instructed on how to do the measurements at the same time and in the same way every day. (BCT: prompt self-monitoring of behaviour and behavioural outcomes; provide feedback on performance)
Forum for debate	Online community for users with a weight problem. The forum made it possible to exchange knowledge, gain social support from peers and build new relationships. The health professionals could also give advice to the forum users and encourage them to contact each other for support (BCT: planning social support/social change)
Who provided	Professional dietician and exercise coach
How	Individually delivered via the e-health tool
Where	Initial face-to-face meetings between the participating patient, their personal doctor and the dietician in the doctor's office. Then mainly web-based delivery.
When and how much	The initial face-to-face consultation with the dietician lasted approx. 45-60 minutes. Thereafter, in a four to six-month period, asynchronous web-based consultations were carried out once weekly with the dietician and every fourth week with the exercise coach. Thereafter (maintenance period), it was possible for both the patient and the dietician to request web-based consultations, typically monthly. (BCT: use of follow up prompts)
Tailoring	Every participating patient received personalized web-based consultations from their designated dietician and exercise coach based on the patient's own inputs online.
Modifications	Only minor modifications were made during the study.

[a] Based on Hoffmann et al 2014 [18]
[b]BCT: behaviour change techniques.
[c]CALO-RE: Coventry, Aberdeen and London-Refined taxonomy[19]

Table 1

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No	Item	Guide questions/description	Page
Domain 1: Research team and reflexivity			
Personal Characteristics			
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	**4**
2.	Credentials	What were the researcher's credentials? *E.g. PhD, MD*	**1**
3.	Occupation	What was their occupation at the time of the study?	**1**
4.	Gender	Was the researcher male or female? Male: CJB,JS, JBN. Female: JC	
5.	Experience and training	What experience or training did the researcher have?	**1**
Relationship with participants			
6.	Relationship established	Was a relationship established prior to study commencement?	**4**
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. *personal goals, reasons for doing the research*	**4**
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. *Bias, assumptions, reasons and interests in the research topic*	**4**
Domain 2: study design			
Theoretical framework			
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? *e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis*	**5**
Participant selection			
10.	Sampling	How were participants selected? *e.g. purposive, convenience, consecutive, snowball*	**3**
11.	Method of approach	How were participants approached? e.g. *face-to-face, telephone, mail, email*	**3**
12.	Sample size	How many participants were in the study?	**3**
13.	Non-participation	How many people refused to participate or dropped out? Reasons?	**3**
Setting			
14.	Setting of data collection	Where was the data collected? e.g. *home, clinic, workplace*	**4**
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	**4**
16.	Description of sample	What are the important characteristics of the sample? *e.g. demographic data, date*	**3**
Data collection			
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	**5**
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	**5**
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data?	**5**

No	Item	Guide questions/description	Page
20.	Field notes	Were field notes made during and/or after the interview or focus group? **5**	
21.	Duration	What was the duration of the interviews or focus group?	**4**
22.	Data saturation	Was data saturation discussed?	**5**
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction? **5**	
Domain 3: analysis and findingsz			
Data analysis			
24.	Number of data coders	How many data coders coded the data? **5**	
25.	Description of the coding tree	Did authors provide a description of the coding tree? **5**	
26.	Derivation of themes	Were themes identified in advance or derived from the data? **5**	
27.	Software	What software, if applicable, was used to manage the data? **5**	
28.	Participant checking	Did participants provide feedback on the findings? **5**	
Reporting			
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? **6, 7, 8, 9** Was each quotation identified? e.*g*. *participant number*	
30.	Data and findings consistent	Was there consistency between the data presented and the findings? **5**	
31.	Clarity of major themes	Were major themes clearly presented in the findings? **6**	
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes? **9, 10**	

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Drivers for successful long-term lifestyle change, the role of e-health: a qualitative interview study

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Drivers for successful long-term lifestyle change, the role of e-health: a qualitative interview study

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ABSTRACT

Objectives: Assisting patients in lifestyle change using collaborative e-health tools can be an efficient treatment for noncommunicable diseases like diabetes, cardiovascular disease and COPD that are caused or aggravated by unhealthy living in the form of unhealthy diet, physical inactivity or tobacco smoking. In a prospective pilot study we tested an online collaborative e-health tool in General Practice. The aim of the study was to identify drivers of importance for long-term personal lifestyle changes from a patient perspective when using a collaborative e-health tool, including the support of peers and healthcare professionals.

Setting: General practice clinics in the Region of Southern Denmark.

Participants: Ten overweight patients who had previously successfully used a hybrid online collaborative e-health tool with both face-to-face and online consultations to lose weight.

Results: The main themes identified were facilitators, barriers and support from family and peers. Establishment of a trustworthy relationship with the healthcare professionals were of paramount importance. It was important for the patients to monitor the measurable outcomes with realistic goals and feedback from a trusted person. Often, significant life events were identified as catalysts for successful long-term lifestyle changes. Dominant barriers to change were perception of insurmountable obstacles, experience of lack of self-efficacy and

excess eating of high calorie food. Finally experiencing of trustworthy person-to-person forums, need for acknowledgement from referent others and support from family and peers were important drivers for long-term lifestyle change.
Conclusion: The most important driver in long-term weight loss was a strong relationship with a healthcare professional. Collaborative e-health tools can support the relationship and behavioural changes through monitoring and relevant feedback. The support from family and peers also matters, and long-term success depends on the ability to establish strong, positive support on a day-to-day basis.

Strengths and limitations of this study

- This study identified drivers for successful long-term lifestyle change among patients having used a collaborative online e-health tool in general practice.
- This study mainly included patients with successful long-term lifestyle change, therefore reasons for lack of engagement and non-adherence might have been overseen.
- Authors CJB and JS both are General Practitioners, which might have influenced their prejudices however, all authors took this in to consideration when analysing the data.

BACKGROUND

Many noncommunicable diseases such as diabetes, cardiovascular diseases, cancer and COPD are caused or aggravated by common preventable risk factors, e.g. tobacco use, unhealthy diet, and physical inactivity. Although being overweight and having an unhealthy lifestyle can be uncomfortable, changing lifestyle is extremely difficult. For weight loss to have a positive impact on health, it needs to be sustainable and especially long-term lifestyle changes (defined as more that 12 to 18 months) have proven difficult.[1] One of the major challenges for lifestyle change seems to be that social relationships that are often challenged by peers, who do not understand the importance of the lifestyle change to the person.[2] This might be one of the reasons why patients find it difficult to acknowledge the complexities and ambivalences that are part of using collaborating e-health tools.[3]

Even though recent systematic reviews have concluded that Internet and mobile interventions can improve lifestyle behaviours, most studies had no more than three to six months' follow up, which emphasizes the need for research in long-term interventions.[4, 5, 6] Most e-health tools and electronic lifestyle monitors use behavioural change techniques such as self-monitoring, goal setting and social support.[7] In systematic reviews, adding personal feedback seems to improve outcome in comparison to automated response feedback.[8]

Several key theories of change from the field of behavioural science are employed in many lifestyle change and e-health tools, and have been used in this study as well. In accordance with social cognitive theory (SCT), a number of constructs come into play when patients try to change lifestyle. SCT has five constructs: (1) measurable outcome i.e. steps, (2) proximal goal setting i.e. daily breakfast, (3) procedural knowledge instead of content knowledge i.e. to walk 10000 steps daily instead of "live healthy", (4) perceived self-efficacy through experiences of reaching planned goals, and (5) social structural factors i.e. the influence of experiencing support (or obstruction) for a healthier lifestyle from family or peers.[9] The Social Action Theory (SAT) takes it one step further and explains how goal-directed action can lead to cognitive change that ultimately restructures the environmental context, including social relations, for long-term lifestyle change.[10] Finally, the theory of triadic influence (TTI) outlines that to be successful, three streams of information need to be recognised: the intrapersonal

stream, the interpersonal stream and the social environmental stream, indicating the complexity of helping a patient change from an unhealthy lifestyle to a healthy lifestyle.[11]

We therefore anticipate that the outcome expectations and goal setting need to be developed in collaboration between a health coaching professional and the patient in order to have a longer-lasting effect for the patient. The Internet and the rise of social media have changed our social patterns, and it has become possible to build relationships via digital tools. Some studies suggest that certain groups of patients might also benefit from this[12].

In a previous study, we found that a collaborative online e-health tool could support a significant weight loss of 7,0 kg during a 20 month period in a general practice setting. The collaborative e-health tool was used in a hybrid manner beginning with a personal meeting and included various behavioural change techniques such as joint goal setting, tailored information, self-monitoring, lifestyle coaching, in-person feedback, reminders, and person-to-person support.[13] A second version of the same collaborative e-health tool showed similar results for men with diabetes, who had an average 5,4 kg weight loss during a 12 month period (compared to 2,8 kg for a control group) in a municipal setting. Semi-structured interviews with patients in the later study suggested that the initial face-to-face meeting was important for building a trustworthy relationship.[14] But overall, the important drivers for such a lifestyle change and what role the collaborative e-health tool played has not previously been addressed.

Hence we aimed to identify drivers of importance for weight loss management for patients who had used a hybrid collaborative online e-health tool for weight loss taking into account the patient's perspectives having experienced a collaborative e-health model.

METHODS

Design

To create new knowledge about the essential themes for this group of patients we used qualitative, semi-structured, individual interviews to explore the field without distraction.

Context

Ten overweight patients from a rural area in the Region of Southern Denmark were recruited for the study. They had all participated in the previous study that utilised a hybrid collaborative online e-health tool also involving face-to-face meetings.

Sampling

Purposive sampling was conducted among patients who had participated in the prior study with regard to gender, age and weight loss. Three men and seven women, ages 34 to 71, average age 52, with an average weight of 109 kg and a median weight loss of 10.5 kg (from 2 to 16 kg) during the 20-month study period were invited. Six had been consistently interacting with the designated healthcare professional during the study, two stopped responding to information given, one left the study early and one never started. Invitations for this qualitative study were by phone and none declined the invitation.

The intervention

The collaborative online e-health tool was used as a supplemental tool for a dietician working in general practice, making sure that the relationship was established in-person before

beginning online communication. The same dietician met the patient in the clinic and handled the online lifestyle coaching with the patient. Apart from the dietician, the patients could meet and share health data/information with other patients in the online forums established through the collaborative e-health tool (Appendix 1). This developed into a strong community where it was also possible for patients to discuss many personal issues[13].

Interview Procedure

The interviews presented in this study took place 5 years after the end of the initial intervention. All patients were interviewed for 45 minutes to 1 hour and a relaxed atmosphere was achieved by holding the interviews one to one in the patients' homes, except for two who preferred to be interviewed in the medical centre. All interviews were carried out by CJB, who has worked as a GP for more than ten years and with different e-health tools for more than 15 years, including the e-health tool used in the intervention. Before every interview, CJB briefly explained the purpose and nature of the research, answered questions, and provided participants with a description of the study in layman's terms. CJB explained to the patients that the interview data would be anonymized, and an informed consent document was signed by both the patient and CJB. The ethics committee for the Region of Southern Denmark reviewed the protocol and found that the Medical Research Involving Human Subjects Act does not apply to this study.[15] A formal approval was therefore not required for this study. We did obtain written consent nevertheless, due to the sensitivity of the subject matter.

Table 1. Interview guide

Fields of interest	**Probing questions**
Disease history	Do you have any diseases? What does that mean to you? What does it mean for your wellbeing? How do you see your health in general?
Experience with taking action to change lifestyle	Have you ever taken the initiative to improve or change your lifestyle? How did it go?
Experience with support from health professionals and peers	Who has helped you with your health challenges? Who has been the best to help you? How? What was the worst experience? How?
Experience with and thoughts about e-health tools	Do you have a smartphone? Have you ever used apps or the Internet in relation to your health or wellbeing? Have you found recipes on the internet? Have you used apps in relation to exercise?

The semi-structured interviews followed an interview guide, which resulted in an iterative approach, for emerging themes and perspectives to be explored.[16] The semi-structured interviews were segmented into four fields of interest: 1) Patient disease history, 2) Patient experiences with taking action to change lifestyle, 3) Patient experiences with support from health professionals and peers, and 4) Patient experiences with and thoughts about e-health tools. See Table 1.

The interview guide was tested among family and colleagues prior to use. All interviews were audiotaped. Field notes were made during and immediately after the interviews.

Analysis

Interviews were transcribed and uploaded to a common database verbatim. Transcripts were analysed by the researchers (CJB, JC, JBN and JS) using thematic analysis. An explorative approach was applied for systematic text condensation.[17 18] The process began with reading the transcripts. After the initial 4 interviews, the authors conducted an overview of the transcripts and identified themes of importance. The authors then agreed on codes across ideas and themes that could be categorized. CJB then coded all transcripts in accordance with the agreed codes. The coded transcripts were shared and discussed. Data from each theme were condensed and summarized into concepts and generalized descriptions. Several times throughout the process, identified themes were compared between the different researchers. Overlap was identified and consistency was reached. Coinciding themes of importance were then put into a common framework. Data collection was terminated due to saturation when no new themes emerged. The quotes that best illustrated the different themes and subthemes were selected and translated from Danish to English by CJB. All quotes were then evaluated by the remaining authors and changes were made to reach agreement among all authors.

RESULTS

All but one of the participants used smartphones or tablets. One only used a traditional cell phone and had his wife entering data via a computer. Five years after the initial intervention, they all still used the Internet or apps for benefitting their health, even though they no longer had access to the intervention tool, www.slankedoktor.dk, described in accordance with (TIDieR) checklist[19] and the CALO-RE: Coventry, Aberdeen and London-Refined taxonomy[20] in Appendix 1.. Everyone looked up recipes, some had joined weight-loss Facebook groups, and some used an app-based service monitoring their physical activity. They were not aware of all the functionality that could support them for free using their smartphones, but the majority acknowledged that the provided collaborative e-health tool had helped them during the intervention period. Following the two years' intervention study five years ago, some had gained weight, but not to the level before the intervention. We identified three main themes: facilitators, barriers, and the support of family and peers (see Table 2).

Facilitators for lifestyle change

A number of subthemes were identified to facilitate long-term lifestyle change, but over all establishing an honest relationship with a healthcare professional, who were trusted to monitor the patient and able to set realistic goals with the patient were most important

The establishment of an honest and trustworthy relationship with the health professional

For all successful lifestyle changes that had lasted for more than three months, the patient could refer to a person whom they trusted and who supported them in their efforts to lose weight. They all had a good and trustworthy relationship with their GPs. Six found support from the dietician involved in the study (including online support), one found support from the GP nurse, one found support from an online coach, one from a spiritual leader, and one

Table 2. Summary of main themes

Facilitators	**Barriers**	**Support from peers and family**
The establishment of an honest and trustworthy relationship with the health professional Monitoring the behavioural change with personal feedback Goal setting Experiencing significant life events igniting the right time for action	The perception of insurmountable obstacles Experience of lack of self-efficacy Excess eating of high calorie food	Experience of honest and trustworthy person-to-person forums Need for acknowledgement from referent others Support from partner/spouse

had not been successful. The four (three men and one woman) who had not found support in the dietician in the intervention were the least successful in the pilot study.[13]

> I think it was really nice to see CA (the dietician), also because she could see it was my head that controlled me a lot. (P2, female)

Some of the patients said that they did not trust the dietician who had been assigned to them nor did they trust the e-health tool, and they identified the lack of trust as the main reason for discontinuing the intervention or seeking other guidance.

> I can't have a settled plan… well, it is more when I told it to her then I said: "it does not work for me. I can't use it in that way", and then I actually did not come back…. (P5, male)

> I felt the trust I had showed had been misused in a way, not that I don't want to join a group and talk about a lot of things, what I have eaten etc….., but all of a sudden another dietician sent me messages and then I said: "now it stops, now it (the information) is off track, that I don't want it and feel I can't control it. (P9, male)

One of the participants established contact with another online lifestyle coach who helped him to achieve a significant weight loss without a single face-to-face meeting, which means

that seven out of ten had used online support for their weight loss and three had found face-to-face support from alternative sources that were better for them.

Monitoring the behavioural change with personal feedback
All patients found it positive that their health professional of choice showed interest in their self-measurements.

> One who had to see that I kept my weight. If not, I would have said I had done it without having done it….. to satisfy others…….
> …and I can't cheat it (An objective activity monitoring fitness app: "Endomondo"). It is not possible for me to pretend I have gone for a walk when I haven't. (P1, female)

Goal setting
Individual goal setting was recognized as difficult. Several patients revealed that they had daily or weekly goals for activity, diet or weight. Daily goals seemed most effective due to the fact that action was needed within small, discrete windows of time.

> Today.. I just have to walk my 10.000 steps, and swim two times a week. And then I eat what I always have eaten except I don't eat that stof (candy), because I'm not tired, so I don't need it. (P8, female)
> Then I stopped eating candy, and I have neither bought or had candy for three months and I have lost 7 kg. (P3, female)

Experienced life events perceived as significant, igniting the right time for action
All patients revealed how a specific situation or life event had ignited their lifestyle change. Five revealed that a specific incident in their family changed their way of thinking with regard to their lifestyle. Three had experienced that their doctor or another health professional had made it clear to them that they had to do something. Two had received an effective treatment that had helped them with their weight control or tiredness to a degree that made it possible to act in a different way.

> ….It was a very specific episode that ignited it (the lifestyle change)… I came home one night very tired…. My husband is on his way to bed, and then he says: "by the way the kids and I found a bag of candy in your handbag that we ate - I hope that is okay?" I then went completely mad and wanted a divorce… , but then during the night, I realized that I had a problem. I had three kids, and I wanted to break up my marriage due to a bag of candy…… (P10, female)

Barriers to lifestyle change

The patients gave many reasons as to why they had difficulties keeping the weight off, both in their own perception of insurmountable obstacles, experience of lack of self-efficacy and in having difficulties with excess eating of high calorie foods, which is explained in more detail below.

The perception of insurmountable obstacles
Several patients described how they used illnesses or other deficits to explain their lack of ability to do something about their health.

> I had this knot under my left foot removed in surgery two years ago. Three months ago, I had the same operation in the other foot. So I'm not able to do it (exercise), and I still can't use regular footwear. I still use sandals. (P1, female)

Experience of lack of self-efficacy

Several patients explained how they often felt tempted to indulge in high-calorie foods, and that their confidence in being able to avoid inappropriate behaviour was low.

> It is probably because I can eat a little candy again or buy a chocolate bar when I'm out shopping…. And I have problems saying no thanks. (P2, female)

Excess eating of high calorie foods

Many of the patients had experiences with their weight going up and down. When they allowed themselves to eat even small amounts of sweets, their weight went up very quickly.

> "It happened very fast. I think it was in December … I allowed myself to eat a cookie… by the end of January, I had gained 10 kg……Just like an alcoholic can't drink half a bottle of wine, then I will never be able to eat 100g of chocolate without having to really hold myself back. (P10, female)

Support from peers and family

As severely overweight people, it is obvious to everyone they meet that they have challenges in relation to their lifestyle. The support from friends and close family was found important, and intrinsic factors that inhibit weight loss can be potentiated or challenged when the person came into contact with other supportive individuals.

The experience of honest and trustworthy person-to-person forums

Most patients found support from friends they had met in their struggle to lose weight. Both relations established in traditional meetings and online forums were described as important.

> "Then I have my friend, whom I met when I joined Weight Watchers. She has all these ideas as to how to combine different food ingredients….. and my other friend has that as well, but she has now joined this online group low fat, high something……" (P6, female)

Several of the patients used Facebook or apps, where they communicated with friends. Several of the patients described how they experienced that they were able to communicate more honestly with their online friends.

> …I'm more in need of a closed group for people who have the same problems as I have or at least are in the same position as I am" and "I could do it (be honest) if it was online, but not if I had to look them in the eyes."
> "If it is someone I would never meet, then I could be honest, but as soon I know that it is someone I am going to meet, then I add to the story. (P2, female)

Need for acknowledgement from referent others

To sustain a lifestyle change, most of the patients said that the most important person was their partner/spouse or another person close to them who continued to regard the lifestyle change as important. For most of the patients, the dietician or another healthcare professional

had been the most important person during the period of lifestyle change. After the study, a number of the patients returned to their old habits, and the lack of support was missed.

> "The worst thing was that nobody called me up and said: "Why is it you have not scheduled a new appointment?" (P2, female)

In the online setting, acknowledgement also made a difference to a majority of the patients.

> I used it (the forum in the e-health tool) a lot. …The fact that I could be honest and put my cards on the table, because they all knew how it is to have the urge to drive to the next baker and empty the store on the way home. So it was actually very important to me that I had that forum. (P10, female)

> "….It is the same with Endomondo (an activity tracker app). I have friends there. And then I have to show I walk. Not to make them believe I'm not active. (P7, female)

Support from partner/spouse

All patients shared their goals and achievements with their close family. Most found their family supportive, but a minority also revealed that the partner/spouse took a judgmental position with regard to their lifestyle choices and some tried to support their partner/spouse through loving teasing.

> ..Before I lost weight my breathing was really bad … and I couldn't sleep at night so I would fall asleep during the day… then I would be reviled by N (partner): "Now you are sitting falling asleep again" I could sit in a chair and fall asleep. (P4, male)

DISCUSSION

We aimed to identify important drivers for long-term lifestyle change for patients using a hybrid collaborative e-health tool and found that establishing a trustworthy relationship with a healthcare professional doing lifestyle coaching was the most important factor for a long-term successful lifestyle change. This matches the social ecological point of view that establishing a good relationship with the patient is of paramount importance for coaching patients to make difficult decisions.[9 21 22] To establish a trustworthy relationship with a healthcare professional can be difficult in a fully online e-health tool. The provided e-health tool in this study utilised a hybrid model, both in-person and online, that seemed to strengthen the relationship with the healthcare professional even though some patients found strong and consistent support by themselves outside the GP setting or in alternative settings. The main reasons for non-adherence was lack of trust in the dietician, and lack of trust in the e-health tool, which is in line with other studies examining reasons for noncompliance with e-health tools.[23]

Goal setting and monitoring the behavioural change are important for many patients, but it needs to be delivered empathically and only when relevant. Goal-directed action is the basis of the social action theory[10] and, by using e-health tools, this can be done real-time both objectively (via accelerometers in smartphones, using apps such as Google Fit, Apple's built-in

Health app, or Endomondo) and subjectively through reporting. Lifestyle changes were often ignited by a specific event. This event could be intrinsic, from a perceived significant life event for the individuals or their close family, or extrinsic, such as an eye-opening talk with a health professional or an effective treatment that helped the patient decide that weight loss or other lifestyle changes were important enough to make a change.

Barriers centred around perceived insurmountable obstacles, lack of self-efficacy, and excess eating of high calorie foods, which very much related to the intrapersonal stream described in the Theory of Triadic Influence (TTI).[11] To close the gap and reach their goals despite these barriers, patients described how the support they experienced both offline and online from referent others made a huge difference. This interpersonal aspect is the second stream in TTI and confirms that meeting others in the same situation is important.

The third stream in TTI is the sociocultural environment that changes to some extent when a person meets new people (including online) who also want to lose weight. That is, you can change your referent others ("friends") online, something that might be of importance in the future, especially for people from lower social classes, with little support from home, or who live alone[12]. Many of the same psychological support elements via change of reference others are found in other successful lifestyle change groups such as Alcoholics Anonymous and/or Overeaters Anonymous. Lastly, close family play an important role for our participants. The participants all reported support from their family as important during their weight loss, which is in accordance with the social cognitive theory underlying the importance of the opinion of referent others.[9]

Strengths and limitations of this study

This is the first qualitative research study exploring drivers for successful long-term lifestyle change using a collaborative online e-health approach in general practice. The digital revolution makes it difficult to detect general principles for successful e-health tools before they are out-dated; instead, this qualitative study explores themes of importance across various persuasive technologies and collaborative e-health platforms that could not be highlighted in a quantitative study. It is a potential weakness that we do not know if our sample was more technically savvy than the average population, which should be addressed in future studies. On the other hand the access to new technologies becomes easier all the time why we believe the principles outlined in this applies study to most patients.

This study mainly included patients with successful long-term lifestyle change, meaning reasons for lack of engagement and non-adherence might have been overseen.

The study did not look at perspectives of individuals in relation to their outcomes; with more individuals and methodological triangulation, this might have revealed the quantitative importance of the identified themes. The result of this study is probably generalizable and supports the notion that the implementation of collaborative e-health tools might have the potential to change patient lifestyles via low-cost support for healthy living. The preconception of the authors' CJB and JS, who are GPs, might have compromised the objectivity of the data in interviews and analysis, even though it was taken into account in the analysis. Future research needs to examine the perspectives of GPs and healthcare professionals who assist patients using collaborative e-health tools, in order to better understand the perspectives of all stakeholders.

CONCLUSION

A strong relationship with a healthcare professional or another person with coaching ability is essential for long-term successful weight loss when using e-health tools. The collaborative e-

health tool can be viewed as a supplement to the professional empathic relationship and support behavioural change through monitoring and empathic, relevant feedback. The opinions of family and peers matter. Long-term success with lifestyle change depends on the ability to establish strong positive support on a day-to-day basis, which can be supported by e-health tools. The patient needs to feel that the healthcare professional cares for her/him if she/he is going to be successful with a long-term lifestyle change. The present findings are probably generalizable to the use of collaborative e-health tools and have formed the basis of the later development of a collaborative e-health tool using focus group interviews in a 'thinking aloud' protocol where the patients interact with the app and healthcare professionals interact with the backend control panel,[24] that is going to be used in a future study.[25]

Contributor statement:
CJB, JC, JBN and JS have all contributed substantially to the conception and the design of the work, analysis and interpretation of data.
CJB, JC, JBN and JS have all been involved in drafting and revising the article critically for important intellectual content.
CJB, JC, JBN and JS have all approved the final version attached, will approve the final published version and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interest:
Carl J. Brandt owns stock in LIVA Healthcare ApS, the company that has developed parts of the technical platform used by the patients in the pilot study.

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Data sharing statement:
All 10 interviews can be provided in Danish upon request.

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Appendix 1. (TIDieR) checklist[a] for the former Slankedoktor.dk - A web-based weight loss intervention

TiDieR checklist item	Description
What Online weight loss coaching by dietician and exercise coach	The dietician, who initially met the participating patient face-to- face in the doctor´s office, also provided online lifestyle coaching using the interactive web-based weight loss program. To gain access to the e-health tool, the patient had to fill out a comprehensive document online covering his/her medical history, health status, educational level and medicine intake, and accept the sharing of data between the dietician, the doctor and an exercise coach. When consent was given, the patient had access to scheduled web-based consultations and dialog with the dietician and exercise coach through embedded email-style messages sent within the website, an online community "Forum for Debate", and an embedded e-mail chat that connected the patient with other patients participating in the study and with private users, who had purchased access to the service to lose weight in a non-clinical setting. The system was set up to notify the user when new feedback was available and the users could also communicate with other users using functions like comments on entries of food and physical activity inputs and personal pictures. To kick off the initial weight loss period lasting approximately four months, a personal diet plan and exercise plan, based on the first week of day-to-day online registrations of weight measurements, meals and physical activity, was provided to the patient. The subsequent online consultations with the dietician took place weekly. The content of these consultations was at the professional discretion of the health professionals, but overall the focus was on the patient's registrations and questions, information in relation to the patient's weight status and recommendations on how to perform specific behaviours and set new goals. The exercise coach could be consulted online every fourth week in the first four months. If deemed necessary by the dietician, a patient could see the dietician face-to-face in the doctor's office in between the scheduled online consultations, within the first two to three months of the study period. Overall, face-to-face consultations in the doctor's office with the dietician were planned to take place every third and sixth month. Included BCT[b] from the CALO-RE taxonomy[c] (hereafter referred to as BCT): provide feedback on performance; provide instruction on how to perform the behaviour; provide information on consequences of the behaviour in *general* and *to the individual*; goal setting: behaviour and outcome; action planning; barrier identification/problem solving; relapse prevention and coping planning; prompt practice; plan social support/social change) The inputs described underneath this column are available to the patient and are an important part of the intervention. The patients can keep record of specified behaviour(s) on a daily, weekly or monthly basis. If the patients make their registrations daily, it becomes possible for both the health professionals and the patient to follow progress or setbacks closely, as the numbers and registrations are visualized with graphs and curves. (BCT: goal setting: behaviour and outcome; prompt self-monitoring of behaviour; provide feedback on performance; prompt practice)
Daily food intake input	Reporting of daily food intake: type of foods, amounts and time consumed can be compared to the personal diet plan. This makes it possible to advise and support the patient in getting a more balanced diet, e.g. eating smaller meals throughout the day, getting more vegetables and fruit, less carbs, fat and sugar and choosing whole-grain options when possible. (BCT: provide feedback on performance; prompt self-monitoring of behaviour)

My healthy cookbook	The patients can access and share recipes and links to websites with healthy cooking instructions among each other, the feature is supervised by the dietician on request. (BCT: prompt practice; facilitate social comparison)
Physical activity input	Recording of type, time and intensity of any physical activity. The patients are taught how to set realistic goals and receive advice on different activities and how to implement them in daily life. They also learn how to convert activity into calories burnt, to get a better understanding of the balance between energy intake and energy output. (BCT: provide instruction on how to perform the behaviour; prompting generalization of a target behaviour; relapse prevention/coping planning)
Weight measurements input	Recording of current weight and goal weight, and reporting of waist measurements to display progress. The patients are instructed on how to do the measurements at the same time and in the same way every day. (BCT: prompt self-monitoring of behaviour and behavioural outcomes; provide feedback on performance)
Forum for debate	Online community for users with a weight problem. The forum made it possible to exchange knowledge, gain social support from peers and build new relationships. The health professionals could also give advice to the forum users and encourage them to contact each other for support (BCT: planning social support/social change)
Who provided	Professional dietician and exercise coach
How	Individually delivered via the e-health tool
Where	Initial face-to-face meetings between the participating patient, their personal doctor and the dietician in the doctor's office. Then mainly web-based delivery.
When and how much	The initial face-to-face consultation with the dietician lasted approx. 45-60 minutes. Thereafter, in a four to six-month period, asynchronous web-based consultations were carried out once weekly with the dietician and every fourth week with the exercise coach. Thereafter (maintenance period), it was possible for both the patient and the dietician to request web-based consultations, typically monthly. (BCT: use of follow up prompts)
Tailoring	Every participating patient received personalized web-based consultations from their designated dietician and exercise coach based on the patient's own inputs online.
Modifications	Only minor modifications were made during the study.

[a] Based on Hoffmann et al 2014 [18]
[b]BCT: behaviour change techniques.
[c]CALO-RE: Coventry, Aberdeen and London-Refined taxonomy[19]

Table 1

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No	Item	Guide questions/description	Page
Domain 1: Research team and reflexivity			
Personal Characteristics			
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	**4**
2.	Credentials	What were the researcher's credentials? *E.g. PhD, MD*	**1**
3.	Occupation	What was their occupation at the time of the study?	**1**
4.	Gender	Was the researcher male or female? Male: CJB,JS, JBN. Female: JC	
5.	Experience and training	What experience or training did the researcher have?	**1**
Relationship with participants			
6.	Relationship established	Was a relationship established prior to study commencement?	**4**
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. *personal goals, reasons for doing the research*	**4**
8.	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. *Bias, assumptions, reasons and interests in the research topic*	**4**
Domain 2: study design			
Theoretical framework			
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? *e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis*	**5**
Participant selection			
10.	Sampling	How were participants selected? *e.g. purposive, convenience, consecutive, snowball*	**3**
11.	Method of approach	How were participants approached? e.g. *face-to-face, telephone, mail, email*	**3**
12.	Sample size	How many participants were in the study?	**3**
13.	Non-participation	How many people refused to participate or dropped out? Reasons?	**3**
Setting			
14.	Setting of data collection	Where was the data collected? e.g. *home, clinic, workplace*	**4**
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	**4**
16.	Description of sample	What are the important characteristics of the sample? *e.g. demographic data, date*	**3**
Data collection			
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	**5**
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	**5**
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data?	**5**

No	Item	Guide questions/description	Page
20.	Field notes	Were field notes made during and/or after the interview or focus group? **5**	
21.	Duration	What was the duration of the interviews or focus group?	**4**
22.	Data saturation	Was data saturation discussed?	**5**
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction? **5**	
Domain 3: analysis and findingsz			
Data analysis			
24.	Number of data coders	How many data coders coded the data? **5**	
25.	Description of the coding tree	Did authors provide a description of the coding tree? **5**	
26.	Derivation of themes	Were themes identified in advance or derived from the data? **5**	
27.	Software	What software, if applicable, was used to manage the data? **5**	
28.	Participant checking	Did participants provide feedback on the findings? **5**	
Reporting			
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? **6, 7, 8, 9** Was each quotation identified? e.*g*. *participant number*	
30.	Data and findings consistent	Was there consistency between the data presented and the findings? **5**	
31.	Clarity of major themes	Were major themes clearly presented in the findings? **6**	
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes? **9, 10**	