**Title:** *(name of the intervention - blinded for peer review)*: Acceptability and feasibility of a theory-based, online-delivered, tailored weight loss and weight loss maintenance intervention

**Abstract**

**Background:** Fewweight loss and weight loss maintenance interventions are tailored to include factors demonstrated to predict the user’s behaviour. Establishing the feasibility and acceptability of such interventions is crucial.

**Purpose:** Toassess the acceptability and feasibility of a theory-based, tailored, online-delivered weight loss and weight loss maintenance intervention *(blinded for peer review)*.

**Methods:** A mixed methods process evaluation of the *(blinded for peer review)* tailored intervention, nested in a randomised controlled trial (*N*=288) with an embedded N-of-1 study, investigating participants’ and implementers’ experiences related to intervention context, implementation, and mechanisms of impact. Measures included: (1) surveys, (2) data-prompted interviews (DPIs) with study participants, (3) semi-structured interviews with implementers, (4) intervention access and engagement data.

**Results:** Five themes described the acceptability of the intervention to participants: (1) monitoring behaviour change and personal progress to better understand the weight management process, (2) working collaboratively with the intervention implementers to achieve participants’ goals, (3) perceived benefits of non-judgmental and problem-solving tone of the intervention, (4) changes in personal perception of the weight management process due to intervention tailoring, and (5) insufficient intervention content tailoring. The intervention delivery was feasible, however, emails and text messages differed in terms of accessibility and resources required to deliver the content.

**Conclusions:** The use of Ecological Momentary Assessment as a technique to gather personal data for further tailoring was acceptable, and facilitated behaviour change monitoring. Personalization of the intervention content above and beyond domain-specific issues, e.g. by addressing participants’ social roles may better match their needs. Support from the implementers and feedback on body composition changes may increase participants’ engagement.

**Keywords***:*weight loss, overweight, obesity, digital health, process evaluation, ecological momentary assessment

**Lay summary**

People with overweight and obesity can benefitfrom participating in behaviour change programs that are individually adjusted to participants’ psychological characteristics. It is important to provide knowledge of how to design acceptable and feasible, widely accessible, sustainable tailored interventions for weight loss and weight loss maintenance. We designed *(blinded for peer review)* - a tailored intervention that matched intervention content to psychological factors that were demonstrated to influence each participant’s behaviour. This study assessed whether the *(blinded for peer review)* program was acceptable and feasible from the point of view of program participants and people who worked directly with the participants. The intervention tailoring supported participants in changing the way they thought about the weight loss process, and regular tailored messages served as a cue to maintain healthy habits. However, tailoring based on psychological characteristics was insufficient for many participants, as they would have preferred more personalised content. We provide guidance on good practices to gather data for tailored support, to monitor behaviour change progress, and for communicating with participants, to improve acceptability of tailored interventions. We also compare how acceptable participants found methods of the intervention delivery (SMS messages, emails, handbook) to advise which methods are the most acceptable and preferred by participants.

**Introduction**

Overweight and obesity are complex conditions (World Health Organization, 2019), with many possible etiological factors and contextual influences. To provide effective treatment for people living with overweight and obesity, there have been calls to move beyond one-size-fits-all solutions (Flint & Batterham, 2023; Kelsey & Pagidipati, 2021). Tailored interventions for weight management show promise as a method to effectively support this population to lose and maintain weight loss by changing health behaviours, and can increase weight loss (Ryan et al., 2019). Through tailoring, interventions can be customised on the basis of individual characteristics (Noar et al., 2011). Evidence-based digital interventions containing individually acceptable features may offer an efficient alternative to traditional face-to-face counselling (Beck et al., 2010). Personalised feedback and promotion of regular use of eHealth technologies maximises participants’ engagement in tailored, digital interventions (Whiteley et al., 2024). A better understanding of implementation mechanisms, including the ways participants’ interact with tailored, digital interventions may help to develop more effective, implementable and scalable weight loss programs.

We designed a tailored, theory-based intervention to support people in losing weight and maintaining it long term *(blinded for peer review)*. We tested twelve, theory-based factors that are related to health behaviour change and maintenance (Kwasnicka et al., 2016). Personal factors that influence individual weight management were investigated using Ecological Momentary Assessment (EMA) to inform intervention tailoring. EMA involves regular, real-time sampling of participants’ behaviours and experiences, performed in their natural environments (Perski et al., 2022; Shiffman et al., 2008). The intervention was evaluated in a two-group randomised controlled trial (RCT) *(blinded for peer review)*. In this article, we will report on the process evaluation of the *(blinded for peer review)* intervention.

To advance tailored interventions for weight management, there is a need to research implementation processes, implementation outcomes, and to identify and describe mechanisms of participants’ engagement and behaviour change. Common implementation outcomes taken into consideration include acceptability and feasibility (Proctor et al., 2023). Evaluation of these outcomes can help identify how participants engage with the intervention, and factors that influence acceptability of particular elements of the intervention. A systematic approach to evaluation of these implementation outcomes may facilitate a better understanding of the interdependencies that occur in the intervention. Evaluation of the implementation outcomes also enables assessment of implementation of the intervention in the specific situational, economic, and geographical contexts. Implementation and context are inseparable, especially if we understand contextual factors as dynamic interactions, roles, and relationships, beyond the geographical level (Pfadenhauer et al., 2017).

*Acceptability* is defined as the perception among implementation stakeholders (including participants) that a given treatment, service, practice, or innovation is appropriate, agreeable, palatable, or satisfactory (Proctor et al., 2011; Sekhon et al., 2017). Programs considered acceptable by participants are more likely to induce behaviour change (Stok et al., 2016). To assess the level of acceptability in a complex intervention, intervention providers need to explore affective and cognitive attitudes, perceived effort and burden of the intervention, individual levels of self-efficacy, and perceived effectiveness of the intervention (Sekhon et al., 2017). Importantly, equitability of the interventions and thus reducing health inequalities, are the function of acceptability and feasibility of the interventions (Proctor et al., 2023). *Feasibility* can be defined as the extent to which the delivery of the intervention may be successful, given the context and setting in which the intervention is conducted, as well as the as the extent to which an implementation target (e.g., the breadth of the reach, attrition, equitability) can be successfully achieved (Proctor et al., 2011). Evaluation of acceptability and feasibility provide insights on the implementation, mechanisms of impact, and contextual factors that shape a complex process of delivery of a health-promoting intervention (Moore et al., 2015),which has been achieved in previous health interventions tailored to participants’ characteristics (Kwasnicka et al., 2021).

The aims of this study were: (1) to assess the acceptability of the intervention, particularly regarding the use of a 3-month period to gather EMA data to then subsequently inform intervention tailoring; (2) to determine feasibility of the intervention delivery for the study participants and the intervention implementers.

**Methods**

**Design of the *(blinded for peer review)* trial**

The *(blinded for peer review)* study was a two-group RCT with embedded N-of-1 interrupted time series. The protocol of the trial is published elsewhere *(reference blinded for peer review)*. Co-design of the intervention followed the Intervention Mapping approach (Barthomolew Eldridge et al., 2016) and is published elsewhere *(reference blinded for peer review)*. We recruited 288 study participants (16 % men, 84% women, age: 21-71, *M*= 36, *SD*= 9.89; BMI 25-50, *M*= 32, SD= 4.62)via social media advertising, partnering with local communities and not-for-profit organisations, and advertisements placed on the university website. Recruitment activities occurred between March and October 2020 and study measurements were collected between July 2020 and April 2022. The trial took place in Poland (Wrocław, Lower Silesia voivodeship). All participants were from Lower Silesia or neighbouring regions, as objective measures were collected during face-to-face meetings with the intervention implementers.

Both groups (intervention and control) completed study measures at baseline, 3 months, 6 months and 12 months. Throughout the trial, each participant met four times with an implementer, who provided a body composition analysis (scale model: Tanita MC-780 S MA, Japan) in conjunction with a detailed printed report. Implementers explained to the study participants how to interpret body composition data measures. Before receiving treatment, intervention participants collected daily EMAs to identify the strongest predictors of their weight loss plan adherence. Participants from the intervention group were informed after baseline that the EMA was used as a data gathering method to build their personalised and tailored intervention afterwards. Every participant assigned to the intervention group could choose a convenient time of a day to receive a SMS reminder about the daily survey. The daily assessments were collected for 90 consecutive days. Each intervention participant’s EMA data were then analysed using time series analysis to identify the strongest predictors of their self-reported weight loss plan adherence. The 12-week intervention was then tailored to the strongest predictors and included daily SMS messages and weekly emails, containing the tailored evidence-based advice (Figure 1). All study materials, including the intervention content, were published in the Open Science Framework (*blinded for peer review*).

The trial measurements were taken by five implementers (all with Master’s degrees in psychology). Two of the implementers were involved in the intervention content development, preparation of the detailed trial procedures, and recruitment. The other three implementers were then trained in study procedure, based on the standard operating procedures (SOPs).



**Figure 1.** An overview of the tailored intervention steps in the (blinded for peer review) trial

**Design of the process evaluation**

We investigated the acceptability and feasibility of the intervention, focusing on three key aspects of process evaluation: context, implementation, and mechanisms of impact, which follows the guidelines of the UK Medical Research Council (Moore et al., 2015). The process evaluation of the *(blinded for peer review)* intervention included: (1) surveys completed by the study participants at 6- and 12-month post baseline follow-up meetings, (2) data-prompted interviews (DPIs) (Kwasnicka et al., 2015) conducted with participants at the conclusion of the trial, (3) semi-structured interviews with implementers, (4) and intervention access and engagement data.

***Surveys from the intervention participants***

Data from 6- and 12-month follow-up surveys were collected in advance of a measurement meeting and gathered anonymously. Structured survey items assessed participants perceptions of acceptability of the interventions’ attractiveness, affective response, informational value, and acceptability of the online-delivered content of the intervention, all rated on a 1-100 scale (*1 – totally unacceptable, 100 – fully acceptable*). Open-ended items included questions about perceptions of health behaviour changes that occurred during the *(blinded for peer review)* trial, personal experiences of taking part in the intervention, and suggestions for improvements.

***Data-prompted interviews with the intervention participants***

We conducted 26 semi-structured, data-prompted interviews (DPIs) with participants (Table 1). Data-prompted interviews are based on personal data to stimulate discussion (Kwasnicka et al., 2015) and have been used to explore weight loss and weight maintenance experiences (Kwasnicka et al., 2019). Data-prompted interviews were designed to explore participants’ experiences in the *(blinded for peer review)* trial, perceived facilitators of, and barriers to behaviour change throughout the intervention. We also explored weight loss and weight loss maintenance strategies used during the intervention, and those planned to be continued after the conclusion of the trial.

During the interviews, we used body composition reports summarising data gathered throughout the study and the EMA data analysis reports summarising individual factors influencing weight loss and weight loss maintenance. The interviews were conducted face-to-face by the researcher (IPP), after the 12-month follow-up meetings, which were the final participant meetings in the *(blinded for peer review)* trial.

The interview protocol (Supplementary File 1) was prepared by one researcher (IPP) and reviewed by another investigator (DK). The interviews took place between July 2021 and May 2022, and lasted between 18 and 43 minutes (*M* = 27 min; *SD* = 6 min).

***Interviews with the intervention implementers***

All intervention **i**mplementers (*N*=4; all women; all with Master’s degree in psychology, all Polish, age: 27-33, M=27,67; SD=2,17) were asked to participate in semi-structured interviews to explore their experiences of delivering the *(blinded for peer review)* intervention, their suggestions for future improvements, individual challenges, and intervention components that worked well and did not work well (Supplementary File 2). Interviews were conducted face-to-face and lasted between 22 and 31 minutes (*M* = 24 min; *SD* =1 min).

***Intervention access and engagement among intervention participants***

Intervention delivery was automatized via dedicated software (*Redlink* for SMS messages delivery and *Mailerlite* for emails). We were able to assess how many participants opened each email and how they engaged with it (e.g., opened a link in the message, as we included the link in every email to the *(blinded for peer review)* website and social media), using email tracking reports provided in the email delivery system. Every participant was informed that email delivery would be tracked to assess reach and feasibility of this content delivery method. All participants received a study handbook at baseline (printed or e-book) and we assessed which form was preferred. The handbook included generic information on healthy diet, weight loss process, and physical activity.   
***Ethics Approval*** All study participants (intervention participants and intervention implementers) were provided with detailed procedure information prior to giving consent and taking part. Ethical approval was granted by (reference blinded for peer review), approval number: 03/P/12/2019.

**Data analysis**

Qualitative data (open-ended survey comments, data-prompted interviews with the intervention participants, and semi-structured interviews with the intervention implementers) were analysed using principles of reflexive thematic analysis (Braun & Clarke, 2019). Data-prompted interviews with the intervention participants and interviews with the intervention implementers were recorded and transcribed verbatim. Afterwards, transcripts were checked for accuracy and data were coded by IPP according to the study aims, focusing on the intervention acceptability and feasibility of the intervention delivery. The codes were indexed in a preliminary thematic map, and then were reviewed by DK to ensure that they represent the meaning related to the study aims, as well as implementation, mechanisms of impact, and the contextual factors. The decision to stop data collection was based on the agreement of both coders that the study reached sufficient data saturation (Saunders et al., 2018) and no new themes were distinguishable. The final themes were generated using a reflexive approach, including team-reflexive discussions (Olmos-Vega et al., 2023), that were structured around researchers’ perspectives on the intervention (IPP coordinated the implementation of the intervention, DK was a leader of the research project that included this study). Data were then systematically translated, according to recommendations for cross-language quotes (van Nes et al., 2010). Quantitative data from the structured questions in the feedback surveys for the intervention participants and the intervention delivery systems were analysed using descriptive statistics.

**Results**

**Acceptability of the intervention**

In order to assess interventionacceptability, we quantitatively assessed several key features. Affective response was assessed as positive (*M*=73.03, *SD*=25.24; 0-100 scale). Perceived attractiveness of the intervention was moderate (*M*=67.07, *SD*=29.38; 0-100 scale), as was the informational value of the intervention (*M*=61.38, *SD*=27.50; 0-100 scale). The participants rated the online form of the intervention as moderately valuable (M= 68.13, *SD*=29.67; 0-100 scale).

The qualitative findings relating to intervention acceptability are based on data gathered through: data-prompted interviews (DPI), anonymous feedback surveys, and semi-structured interviews with the intervention implementers. Findings are described through five themes. Participants’ quotes are derived from data-prompted interviews (DPIs); including personal characteristics: participant number, BMI at baseline, gender, or are obtained from anonymous feedback surveys (marked below as: ‘survey’).

***Theme 1: Monitoring behaviour change and personal progress to better understand the weight management process***

Participants described EMA as a useful way to reflect on the day and a part of their behaviour change process:

*“I treated the questions mainly as a monitoring technique, to understand how a day actually went. Mainly, because weight loss should not be treated as a separate thing, it should be embedded fully in my daily life.”* (DPI, participant no. 235, BMI = 32.4, woman)

Moreover, participants reported that the daily EMA surveys increased their motivation to adhere to their plans in terms of health behaviours (e.g., diet, physical activity, weight monitoring). Additionally, daily surveys were a form of ‘staying in touch’ with the implementers and that also facilitated motivation for health behaviour change:

*“I felt satisfied, it was very motivating for me, even though the messages were sent out automatically, I had this feeling that I had a connection; a form of contact with people who are engaged with me and who care.”* (DPI, participant no. 205, BMI = 31.6, man)

Even though the EMA helped participants to monitor their health behaviours, there was a group of participants who indicated that surveys were tiring or boring, especially during the final surveys.

Body composition data were provided at regular time intervals, and were perceived as reliable feedback on the weight loss progress. The participants said that the reports helped them maintain health behaviours aligned with their goals, and work on behaviours that needed improvements:

“*Seeing actual progress has been motivating, and there is enough data to see a full picture of my health. It’s not just weight, size, and BMI.”* (DPI, participant no. 219, BMI = 29.4, woman)

Realising what weight loss involves from the body composition analysis (e.g., body fat reduction, fluctuation in muscle mass or water retention percentage) was a breakthrough in participants’ understanding of the weight loss process. This process, that occurs during weight loss, enabled some participants to engage in and take ownership of their health behaviours:

“*The results showed that it was high time to get interested in my own weight and to start to monitor my weight, and not let the weight take control.”* (DPI, participant no. 27, BMI = 28.9, woman)

***Theme 2: Working collaboratively with the intervention implementers to achieve participants’ goals***

Before the start of the tailored intervention, each participant discussed personalised reports with an intervention implementer. Personalised reports included information about individual factors that influence personal weight loss progress. Participants suggested that the report itself, and discussion with an intervention implementer, provided an opportunity to monitor their behaviours and health outcomes. Most participants agreed with the results of the report and stated that they had observed the reported individual factors for weight loss and weight loss maintenance before, although they felt it was often hard to understand or verbalise these connections.

*“I was not surprised by the results, it was a confirmation of something I felt, but never been able to define. After reading the report, I was able to pinpoint it exactly, and it was also easier for me to spot specific situations, and potentially respond to them.”* (DPI, participant no. 281, BMI = 30.5, woman)

The discussion of the personalised reports with the implementers, after 90 days of EMA, was perceived as an important element of the intervention. Participants had an opportunity to reflect on the factors that may influence their weight loss, and they often treated the results of the EMA as a guidance for formulating their further weight loss plan. The participants and implementers suggested that having an opportunity to monitor the results in real time (e.g., via mobile application) would increase engagement with the intervention.

The complexity of the intervention required ongoing support from implementers to help the participants understand the elements of the intervention and to engage in them. The implementers led in-person sessions, set up the automatized intervention content, and were at the disposal of participants throughout the trial, if they had any questions. It was reported that the opportunity to consult a trained psychologist every few months was an asset of the intervention. Participants stated that meetings with implementers added value to their experience of the online-delivered intervention, as it helped them orientate themselves towards the flow of the intervention, and understand the assumptions and goals of the intervention. It also helped to reflect on their progress and receive a clear overview of the next steps. Implementers were often perceived as partners in the process of behaviour change, even though the meetings were held in a non-prescriptive manner, as the implementers did not suggest specific weight loss goals for the participants. Many participants described how the meetings motivated them to adhere to their weight loss plan:

*“The meetings were important to me, I liked that there was a conversation, that there was an analysis, and there was support explaining what’s next. It motivated me that someone is taking care of me and we work together to achieve my goals.”* (survey participant, anonymous)

The intervention took place during the COVID-19 pandemic. Several participants reported that an opportunity to consult a psychologist during a face-to-face meeting was a valuable experience, when all other forms of human contact and human interactions were restricted.

***Theme 3: Perceived benefits of a non-judgmental and problem-solving tone of the intervention***

Both text messages and emails were written with the intention to avoid a negative or judgemental tone, aiming to foster participants’ internal motivation *(reference to co-design article blinded for peer review)*. This approach meant that participants were able to choose behaviour change techniques that were the most appropriate and aligned with their preferences:

*“Something I really liked, was that the messages had such a friendly and non-judgmental tone. It was like: “Hey, we want to show you this. Check it out! Do what you want, but at least look at this and maybe you'll want to live in another way.”* (DPI, participant no. = 235, BMI = 32.4, woman)

A non-judgemental tone was particularly appreciated by participants who experienced any forms of discrimination due to living with overweight or obesity:

*“The open-mindedness of people that I met was great, I never heard anything negative about myself here, only words of support. I usually receive negative and judgemental comments when it comes to my weight.”* (survey participant, anonymous)

The intervention contained messages that referred to obstacles, lapses and relapses in the process of health behaviour change. Considering difficulties as a common factor in a weight loss process was helpful for participants. It was particularly important that the intervention emphasised problem-solving based on individual resources. Focusing on personal resources used for coping with obstacles, was often mentioned by participants at the final stage of the trial as something that supported long-term weight loss maintenance:

*“The program taught me that obstacles are a natural part of life, and that there is no need to give up. Some minor setbacks are not the end of the world, and despite them, I can continue and just go on.”* (survey participant, anonymous)

***Theme 4: Changes in personal perception of the weight management process due to intervention tailoring***

Regular SMS and email content, tailored on the basis of EMA data, served as a reminder, or a cue, to maintain healthy behaviours. Even though many participants reported that SMS messages were relatively basic in terms of their informative value (limited to a maximum of 160 characters), this form of support was perceived as helpful to maintain health behaviours, especially after a lapse or relapse. The tailored intervention was perceived as something new, an alternative to the weight loss programs the participants had experienced before. The participants said that tailored content encouraged them to reflect on their own behaviours, and helped them to change previous beliefs about dieting and healthy lifestyle. The tailored intervention motivated participants to focus on their own needs, and, therefore, changed their perception of the weight loss process. It was common that the ultimate goal, set by participants during the intervention, was not only weight loss, but change in their attitudes towards weight and health, focused on their own preferences and lifestyle:

*“Honestly, it was very nice that nothing was really imposed in the program. We were able to adjust everything, adjust it to our needs, and to our thoughts and everything else. It does not work like a typical diet, just for the sake of losing weight, but it changes your way of thinking about weight loss, taking care of the body and health in general.”* (DPI, participant no. = 176, BMI = 34.3, woman)

Participants described having had a chance become aware of many psychological or environmental factors that influence their weight management. They reported changing their perspective on the process of weight management – from thinking only about diet and physical activity, to perceiving weight management as a broader process, that is influenced by many factors, that differ on a personal level. The tailored intervention encouraged participants to explore individual reasons underpinning health behaviours:

*“I saw things as if they were under the microscope, because – as I said – you focus on losing weight in a wider sense. Not losing weight, eating less, eating more, but you don’t think about the reasons, where all these things come from, and there are a lot of these factors at play.”* (DPI, participant no. = 219, BMI = 29.4, woman)

***Theme 5: Insufficient intervention content tailoring***

Participants reported that the tailored intervention was not perceived by them as sufficiently personalised. The intervention was based on the domain (or a mix of domains) that, according to the EMA, were the most predictive for the participants (e.g., habit formation, self-regulation) of their weight loss plan adherence, rather than tailored to individual characteristics. Participants were aware that the intervention content was prepared before the start of the trial, and would be programmed by implementers and automated. Some participants reported that they would expect support that is directed specifically to them to maintain motivation for health behaviour change:

*“I would need these text messages to be more personalised, so that it works like a coach – I need more direct messages to motivate me.* (surveyparticipant, anonymous)”

Some participants criticised automatization as a factor that decreased their engagement in the intervention. One person commented that it was hard to relate to messages that were sent automatically as the relevance of the messages and message specificity to the contextual circumstances and preferences was limited:

*“They were sent out automatically, so I did not treat them as something relevant to me.”* (survey participant, anonymous)

There were several aspects that participants suggested should be included to improve personalisation of the intervention. The most common ones were individual lifestyle, and their personal situation. Several participants reported that they would expect that the intervention would align with their current mood, family situation, preferred forms of physical activity, their job, or their social environment. Some participants indicated that poorly tailored messages did not only decrease their motivation, but caused negative reactions. Participants proposed also that they would like to have an opportunity to adjust some parameters during the course of the intervention, as their personal situation may have changed during the 12-months when participating in the intervention. The COVID-19 pandemic was also likely to have increased the need for better personalization, as it caused unexpected changes in participants’ lives (e.g., job change, relocation, limited physical activity options, changes in eating patterns).

**Feasibility of the tailored intervention delivery**

Findings relating to intervention feasibility derive from: interviews with intervention implementers, content delivery tracking methods, and data-prompted interviews (DPI).

At baseline, every participant in the intervention group received a book that included evidence-based information about nutrition, physical activity, and other health behaviours related to weight management. Participants could choose between a printed version or an e-book. The content of the printed and digital versions did not differ. Most participants chose the printed version (n=266, 92.4%), with the remaining choosing the e-book (n=22, 7.6%). Participants, especially those who chose the printed version, reported that the intervention book would be helpful for them in a long-term weight loss maintenance:

*One thing that I promised myself, and it will definitely help me, is to leave the book out, and go back to it. Even though I studied it thoroughly, it will be something, that I will come back to, to remind me, to make sure that this knowledge is still here.* (DPI, participant no. = 205, BMI = 31.6, man)

Text messages were considered as an easily accessible form of regular contact. All participants used their own mobile phones to receive intervention content via text messages. When deciding on a convenient time to receive the daily SMS, participants usually chose the time just after they woke up. From the point of view of the intervention implementers, automatization of the distribution of the text messages was resource intensive, as it required extensive training, and then programming the database of text messages separately for each participant.

The intervention emails were reported by participants as less accessible than text messages during data-prompted interviews and in the surveys. It was often mentioned that intervention emails got lost in their inboxes. The participants reported that this form of the intervention delivery served them in a different way – the text messages were perceived as cues to action or reminders, whereas the emails were longer, and required some time to process and reflect on the content. The majority of the emails were opened on personal computers (95.36%), and only a few participants used their mobile phones to open and read them (4.64%). When defining the convenient day to receive the emails, participants usually chose a day when they knew they would have more time to look through their emails. Overall, 60% of the intervention emails were opened, and 11.7% of participants clicked on the message hyperlinks.

**Discussion**

This study investigated the acceptability and feasibility of a theory-based, online-delivered, tailored weight loss and weight loss maintenance intervention. Our findings refer to the main elements of process evaluations of complex health interventions: implementation, mechanisms of impact, and context (Moore et al., 2015).

**Implementation**

Although the tailored intervention was delivered automatically (via SMS and email), regular follow-up meetings with implementers were important for participants to understand and follow the intervention. It has been previously reported that face-to-face meetings and reminders from implementers improve adherence to digital health interventions (Bennett-Levy et al., 2010; Burke et al., 2017), and they were crucial to maintain engagement with the *(blinded for peer review)* trial. It is possible that the need for personal contact was influenced by the COVID-19 pandemic (Matias et al., 2020; Stieger et al., 2023), as participants frequently mentioned that follow-up meetings with the intervention implementers were unique, especially considering that all implementers were trained psychologists.

**Mechanisms of impact**

The main goal of the *(blinded for peer review)* trial was to test the efficacy of a tailored intervention, in terms of its influence on weight loss and its maintenance. The element of tailoring was perceived as impactful for weight loss and weight maintenance on individual level. Participants reported that tailored support resulted in personal reflection on own health behaviours and redefining individual values in relation to health and well-being. Changes that occur on cognitive level may result in long-term health behaviour change and behaviour maintenance and are important when facing the challenge of overweight and obesity (Montesi et al., 2016). The delivery of tailored content through SMS was more feasible than through emails, although the acceptability of both forms was similar. Regular, tailored SMS content was also reported as desirable in previous research (Nguyen et al., 2015).

We applied twelve theory-based domains for behaviour change and behaviour maintenance (Kwasnicka et al., 2016) as the main components on which we tailored the intervention. Although participants reported that the tailored intervention was more beneficial for them than the potential generic support would have been, they also indicated that the procedures still lacked more personal and context-adjusted content.

The intervention tailoring would benefit from incorporating these factors, as well as demographics (Noar et al., 2011) or gender, as there is evidence for effectiveness and acceptability of gender-sensitive interventions (Kwasnicka et al., 2021; Young et al., 2017). Another way to improve the experiences with the intervention would be providing just-in-time adaptive intervention which provide support based on factors that change in real time (Goldstein et al., 2017; Hardeman et al., 2019; Wang et al., 2014). As the intervention lasted 90 days, and the whole trial lasted 12 months for each participant, the context, personal situation, and preferences may have changed during the process of behaviour change and behaviour maintenance.

It was common for participants to interact with the EMA surveys on two levels: as daily surveys to provide data for further intervention, and as a monitoring tool, which enabled real-time reflection on trajectories of behaviours that were surveyed. Participants had the opportunity to provide data for the tailored intervention and to work on their health behaviour change simultaneously. This mechanism is usually employed in EMA interventions based on feedback provided on an individual level (Heron & Smyth, 2010).

Moreover, personalised reports, based on EMA data, were perceived as a crucial point in the behaviour change process. An opportunity to discuss personal factors that influence weight loss was often described as a breakthrough in thinking about health behaviours on individual level. Sense of relatedness was crucial for participants to sustain motivation, which is in line with the Self-Determination Theory (Ryan & Deci, 2000) that promotes relatedness as one of the main factors that drive intrinsic motivation.

**Context**

Access to weight loss advice, delivered by digital means and by certified health specialists, is limited in Poland (Bieńkowski et al., 2018). Therefore, the *(blinded for peer review)* intervention was an opportunity to receive evidence-based, free of charge support in weight management. We observed that the non-judgemental, and resource-based tone of the intervention was perceived as a valuable counterbalance to programs or campaigns that tend to stigmatise people with overweight and obesity (Kite et al., 2022). In Poland, almost a half of people with obesity experience feelings of discrimination or social exclusion (Hoffmann et al., 2022), which is similar to prevalence of obesity stigma in the US (Brown et al., 2022). Experiences of weight stigma, are often counterproductive for successful weight management (Major et al., 2012, 2014; Schvey et al., 2011). The perceived non-judgemental tone of the intervention supported participants in facing challenges associated with weight stigma. Positive emotional experience, and emphasis on user autonomy and competence, are important to facilitate engagement in health behaviour change interventions (Yardley et al., 2016), and can also result in sustainable changes in physical health (Kok et al., 2013). The supportive approach is often mentioned as more effective intervention style than the instructive style (Karfopoulou et al., 2016). Participants of the *(blinded for peer review)* intervention set their own goals, based on personal resources and preferences. This approach was well received, being one of the main facilitators of the acceptability of the intervention.

The trial took place throughout the COVID-19 pandemic, which was challenging in terms of adjusting the procedures and following relevant safety measures. As recommended restrictions were changing during the pandemic (Bolesławska et al., 2021), we had to adjust the communication and focus on unexpected priorities, such as: limited physical activity during lockdown, increased sedentary behaviours, new nutrition patterns, or need for psychological support in coping with challenges of the pandemic.

**Strengths and limitations**

Using a systematic approach, based on process evaluation guidelines (Moore et al., 2015), enabled us to explore interconnected dimensions of the intervention context, implementation, and mechanism of impact. We used mixed methods to evaluate the intervention, including participants and implementers in the process evaluation. The results are based on measurements collected at 6-month follow-ups (conclusion of the weight loss phase) and at 12-month follow-ups (conclusion of the weight maintenance phase). We documented participants’ attendance and engagement in various aspects of support delivered during the intervention.

Limitations included being unable to track delivery of and engagement with SMS content, which would be beneficial to explore how people interact with the messages.

**Future directions**

In the future, complex, highly personalised interventions can be supported by machine learning. However, it may be a future challenge to replace elements of direct contact with the intervention implementer, regular feedback on progress through body composition analysis, and through explanation of the personal factors used for tailoring. Adjusting the intervention to personal preferences, changing environment, or individual preferences of participants would complement tailoring based on evidence-based domains. Apart from tailoring, the intervention content in weight loss and weight loss maintenance interventions should be rigorously designed to avoid stigmatisation of participants and focus on their personal resources for maintaining behaviour change. Health behaviour change monitoring during health interventions would benefit from combining self-reported progress monitoring with objective measures collected passively.

**Conclusions**

This process evaluation aimed to determine the acceptability and feasibility of an online-delivered, theory-based, tailored intervention for weight loss and weight management *(blinded for peer review)*. The use of EMA as a technique to gather personal data for further tailoring was acceptable, and facilitated behaviour change monitoring. It was particularly important to present and discuss the results of the EMA data analysis with participants, who often mentioned this element of the trial as a key support in their weight loss process. Engagement in the intervention was promoted by the intervention implementers being a source of support for participants, and the regular body composition analysis, treated by many participants as a reliable source of information about individual progress. Participants appreciated non-judgemental tone of the intervention, focused on problem-solving. Regular, tailored messages were treated as a cue or reminder to maintain motivation, and often induced changes in personal perceptions of weight management process. However, domain-based tailoring was usually insufficient for participants, as they would expect highly personalised intervention content. Our findings can support the development and evaluation of other health interventions, as we refer broadly to the processes of health behaviour change and health behaviour maintenance evaluated by the trial participants and implementers.

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Table 1. Demographics of data-prompted interviews’ participants

|  |  |
| --- | --- |
| **Participant characteristics** | **Number (%)** |
| Age (24-62, *M*=41.05, *SD*=13.86)  18-29  30-44  45-59  > 60 | 4 (15%)  11 (42%)  9 (35%)  2 (8%) |
| BMI at baseline (25.4-45.6, *M*=32.07, *SD*=4,70)  25-29,9 (overweight)  30-34.9 (obese, class I)  35-39.9 (obese, class II)  >40 (obese, class III)  Gender  Women  Men | 9 (35%)  11 (42%)  4 (15%)  2 (8%)  17 (65%)  9 (35%) |
| Nationality  Polish | 26 (100%) |
| Employment  Full-time  Part-time  Unemployed | 15 (58%)  5 (19%)  6 (23%) |
| Education  Secondary level  Bachelor’s degree  Master’s degree  Doctoral degree | 8 (31%)  8 (31%)  9 (35%)  1 (3%) |