Original Paper

A Tailored Gender-Sensitive mHealth Weight Loss Intervention (I-GENDO): Development and Process Evaluation

Magdalena Pape[1,2], MSc; Tanja Färber[3], MSc; Caroline Seiferth[2], MSc; Tanja Roth[1], BSc; Stefanie Schroeder[2,3], DPhil; Joerg Wolstein[3], PhD; Stephan Herpertz[1], PhD; Sabine Steins-Loeber[2], PhD

[1]Department of Psychosomatic Medicine and Psychotherapy, LWL-University Hospital of the Ruhr-University Bochum, Bochum, Germany

[2]Department of Clinical Psychology and Psychotherapy, University of Bamberg, Bamberg, Germany

[3]Department of Pathopsychology, University of Bamberg, Bamberg, Germany

Corresponding Author:
Magdalena Pape, MSc
Department of Psychosomatic Medicine and Psychotherapy
LWL-University Hospital of the Ruhr-University Bochum
Alexandrinenstraße 1-3
Bochum, 44791
Germany
Phone: 49 0234 509 ext 59039
Email: magdalena.pape@rub.de

Abstract

Background: Given the increase in the prevalence of overweight and obesity worldwide, the number of digital weight loss interventions has also risen. However, these interventions often lack theoretical background and data on long-term effectiveness. The consideration of individual and gender differences in weight-related psychological parameters might enhance the efficacy and sustainability of mobile-based weight loss interventions.

Objective: This paper presented an introduction to and the process evaluation of a 12-week gender-sensitive mobile health (mHealth) weight loss intervention (I-GENDO) combining computer-based and self-tailoring features.

Methods: Between August 2020 and August 2021, individuals with overweight (BMI 25.0-29.9 kg/m²), those with obesity class I (BMI 30.0-34.9 kg/m²), and those with obesity class II (BMI 35.0-39.9 kg/m²) were recruited to the I-GENDO project, a multicenter study in Germany. The mHealth intervention aimed at targeting individual psychological factors associated with the development and persistence of overweight and obesity (eg, emotional eating) using computer-based tailoring. Moreover, the intervention took a gender-sensitive approach by implementing self-tailoring of gender-targeted module versions. The computer-based assignment of the main modules, self-selection of gender-targeted module versions, and use patterns were evaluated while considering gender. Moreover, gender differences in the usability assessment were analyzed.

Results: Data from the intervention arm of the study were processed. A total of 116 individuals with overweight and obesity (77/116, 66.4% women; age mean 47.28, SD 11.66 years; BMI mean 33.58, SD 3.79 kg/m^2) were included in the analyses. Overall, the compliance (90/109, 82.6%) and satisfaction with the app (mean 86% approval) were high and comparable with those of other mobile weight loss interventions. The usability of the intervention was rated with 71% (5.0/7.0 points) satisfaction. More women obtained the main module that focused on emotion regulation skills. Most men and women selected women-targeted versions of the main modules. Women used the app more frequently and longer than men. However, women and men did not differ in the progress of use patterns throughout the intervention.

Conclusions: We developed a tailored gender-sensitive mHealth weight loss intervention. The usability of and engagement with the intervention were satisfactory, and the overall satisfaction with the intervention was also high. Gender differences must be considered in the evaluation of the effectiveness and sustainability of the intervention.

(JMIR Form Res 2022;6(10):e38480) doi: 10.2196/38480

KEYWORDS

mobile health; mHealth; eHealth; tailoring; gender; weight loss intervention; mobile phone

Introduction

Within the last few decades, a vast number of digital health apps have been developed worldwide [1,2]. eHealth interventions (ie, mobile health [mHealth] interventions) are cost-effective and feasible in everyday life and represent a useful addition to analog health care services, not only in times of a worldwide pandemic [3]. In 2021, 87% of German adults and adolescents aged >14 years owned a smartphone, and 27% reported using mHealth interventions regularly [4]. The use of mHealth interventions requires an active and self-determined engagement of the user and therefore facilitates behavioral changes [5]. For example, mHealth lifestyle interventions show good efficacy in promoting healthy behaviors such as dietary intake and physical activity [6-10]. Therefore, they are promising tools that could promote behavioral change in participants wishing to reduce weight [11]. However, most available interventions to date demonstrate only short-term effects of behavioral change, whereas long-term effectiveness, especially regarding weight loss, has either not been investigated or not been demonstrated [12-14]. An explanation for the lack of effects is that most weight loss apps have not been developed from a scientific background and thus lack sufficient consideration of psychological evidence-based strategies [15], which are an important aspect of effective weight loss programs (WLPs) according to international guidelines [16,17]. Moreover, most weight loss apps have been developed on a *one-size-fits-all* approach, despite indications from prior studies that targeted (tailored) interventions are more effective [18-20].

The term "tailoring" refers to the customization of a feature of an intervention based on the individual characteristics of the participants [21]. The participants might customize an intervention based on their own preferences (self-tailoring), or they might receive individualized interventions in which the program tailors the content, usually based on algorithms (computer-based tailoring). In the latter case, tailoring can be based on data from 1 assessment (static tailoring) or adapted to different assessments within an intervention process (dynamic tailoring). Studies have indicated that participants feel more strongly addressed by individualized interventions, are more satisfied with them, and are subsequently more engaged in their use, which enhances the efficacy of the programs [6,11,19,22-25]. Various psychological aspects are involved in the development and maintenance of overweight and obesity, including the experience of weight-related stigmatization [26], maladaptive coping strategies [27], or dysfunctional eating behaviors [28]. Therefore, developing computer-based tailoring features that consider such psychological aspects might be a key element in the optimization of digital WLPs.

Gender differences in the development and treatment of obesity and overweight have also been investigated [29,30]. In Germany, more men (43.3%) develop overweight (BMI 25-29.9 kg/m²) compared with women (28.8%), but there are no gender differences in the prevalence of obesity (BMI >30.0 kg/m²), with increasing prevalence rates in the past decades among both genders [31,32]. Men with overweight and obesity are less likely to accurately perceive their weight and are less dissatisfied with their overweight status [29]. Moreover, gender differences in physical activity, eating behavior, and weight-related psychological parameters have been reported. For example, women engage more often in problematic eating behaviors, such as emotional eating (EE) and craving of special foods than do men [33]. Women consistently report higher levels of perceived stress and engage more in emotion-focused coping, such as rumination, whereas men often use problem-focused or avoidant coping strategies [34,35]. On average, men are more physically active [36]. Some biological sex differences have been published; for instance, in males, fat depositions are often in the visceral depot, which increases their risk for cardiovascular disorders [37-39]. More women participate in WLPs, yet the participating men lose more absolute weight [40,41]. Results on the adherence to WLPs are heterogeneous, depending on the intervention type, among other factors [42-44]. On the basis of reviewed studies, investigating the effect of gender on overweight and obesity outcomes to improve the effectiveness of WLPs is an important research agenda. A recently published meta-analysis comparing the effects of gender-targeted and gender-neutral WLPs however revealed no differences in weight-related outcomes, although gender-targeted interventions were more effective in promoting activity and improving nutrition [45]. However, the included *gender-targeted* WLPs were offered either to male or to female participants based on sex. We support the idea that psychological interventions should be gender sensitive instead of gender dichotomous and assume an increase in the effectiveness of the intervention if it is gender sensitive [46]. Therefore, to avoid prejudiced gender-based distinctions between individuals with overweight and obesity, we recommend implementing gender-sensitive self-tailoring features.

Against this background, we aimed at developing a smartphone-based psychological and gender sensitive weight-loss intervention with computer-based and self-tailoring features. In the first part of this paper, we have described the development process of the app with particular focus on the tailoring features of the intervention. The subsequent process evaluation focuses on the evaluation of the app with regard to the psychological and gender-sensitive tailoring features, use patterns, and satisfaction with the app derived from a sample of 116 participants taking part in the I-GENDO project [47].

Methods

The I-GENDO Project

The project "Gender-sensitive enhancement of common weight-loss strategies for overweight and obesity: A personalized smartphone app" was proposed by the University of Bamberg, Departments of Clinical Psychology and Psychotherapy and Pathopsychology, in cooperation with LWL-University Hospital of Ruhr-University Bochum, Department of Psychosomatic Medicine and Psychotherapy, and funded by the Federal Ministry of Education and Research of Germany (01GL1719A/B). The project was preregistered (ClinicalTrials.gov identifier: NCT04080193).

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki. The Institutional Review Board of Ruhr-University

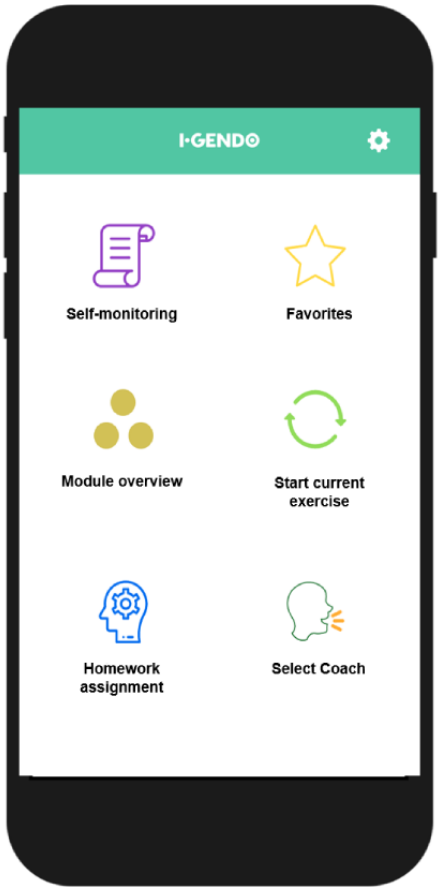
Bochum approved the study (number 18-6415). All participants were informed about the study and provided written informed consent.

Development of the mHealth Intervention I-GENDO

From September 2017 to November 2019, a modular app system was developed at the University of Bamberg in cooperation with an external software provider (groupXS Solutions GmbH).

Figure 1 provides an overview of the I-GENDO app interface. The app provided the following elements: module-based psychological intervention; selection of an accompanying coach; and self-monitoring of hunger, appetite, and mood.

Figure 1. The I-GENDO app interface.



The content of the modules was based on the existing evidence-based manuals, qualitative data from focus groups of individuals with overweight and obesity, and interviews with experts in the field of psychological treatment of obesity. To implement a gender-sensitive approach, extensive literature reviews were conducted on the disparities between genders in the psychological and behavioral aspects of obesity treatment. Furthermore, a steering committee consisting of experts in the field of prevention and treatment of overweight and obesity, digital transformation, and qualitative data analyses was formed. All principal decisions regarding app development were made in consensus with the members of the steering committee.

On the basis of this information, 7 modules that served as the heart of the 12-week I-GENDO intervention were constructed. Of the 7 modules, 2 modules addressed the introduction to (goal setting) and conclusion (relapse prevention strategies) of the intervention. The remaining 5 modules (main modules) focused on different psychological parameters associated with the development and maintenance of overweight and obesity: stress management skills (*stress module*), emotion regulation skills (*emotion module*), dealing with the consequences of overweight (*consequences module*), self-regulation skills (*control module*), and self-efficacy (*self-efficacy module*). Each module contained 9 sessions, which included psychoeducational elements delivered through texts and videos, several therapeutic tools from different therapeutic approaches (ie, cognitive behavioral therapy, dialectical behavioral therapy, and mindfulness), and various behavior change techniques [48]. These sessions could be repeated as many times as desired, and users could set a short link to their favorite exercises via the toolbox.

Each module was presented in either a women-targeted version (*version A*) or a men-targeted version (*version B*), which differed in terms of knowledge transfer, communication style, and prioritization of topics. For example, in the *stress module*, this was achieved using appealing case examples in the women-targeted version and fact presenting in the men-targeted version to transfer general knowledge about stress. Another example is that the men-targeted version in the *emotion module* highlighted and trained the recognition and labeling of emotions, whereas in the women-targeted version, the association between

dysfunctional beliefs and eating behavior was prioritized. Multimedia Appendix 1 [48-77] provides an overview of the operationalization of the gender-sensitive modules and the origin of evidence. The versions were briefly introduced, with both introductions presented on 1 screen page. Participants could then freely choose between *version A* or *B* regardless of biological sex (gender-sensitive instead of gender dichotomous tailoring). Participants were blind to the manipulation of the gender-targeted versions.

Process Evaluation of the mHealth Intervention I-GENDO

From December 2019 to December 2021, the effectiveness of the 12-week I-GENDO intervention was evaluated in a randomized controlled trial conducted at the University of Bamberg and LWL-University Hospital Bochum, Department of Psychosomatic Medicine and Psychotherapy (ClinicalTrials.gov Identifier: NCT04080193). The main results of the randomized controlled trial will be published elsewhere. In this manuscript, the relevant process evaluation data from the intervention arm were analyzed.

Study Sample

Individuals were informed about the I-GENDO project via newspaper articles, radio features, and oral presentations at rehabilitation centers. Participants interested in the study were screened for eligibility (Textbox 1) and, if eligible, were invited to participate. According to the guidelines of the German Association for the Study of Obesity and the German Society for General and Visceral Surgery, individuals with obesity class III (BMI >39.9 kg/m^2) experience a complex multifactorial framework of severe social, mental, and physical problems and are recommended to undergo bariatric surgery. Therefore, we excluded individuals with obesity class III from participation but provided further support. Because the effect of bariatric surgery on weight loss is mainly driven by physical limitations and varies significantly between the types of operative procedure [78], we decided to exclude individuals who underwent or planned to undergo bariatric surgery. The total study sample consisted of 213 individuals with overweight and obesity, of which 116 (n=77, 66.4% women) were randomly assigned to the intervention group for this study and subsequently included in this analysis.

Textbox 1. Eligibility criteria of the I-GENDO project.

Inclusion criteria

- Legal age (≥18 years)
- Obesity class I or II with subjectively experienced weight-related impairment and a current intention to lose weight
- Overweight (ie, BMI between 25 and 29.9 kg/m²) with weight-related health problems, visceral adipose tissue, or high psychosocial weight-related distress and a current intention to lose weight

Exclusion criteria

- Obesity class III (ie, BMI >39.9 kg/m²)
- Current (or within the last 12 months) involvement in a structured weight loss intervention
- Insulin-dependent type 1 diabetes
- Previous or intended bariatric surgery
- Current psychotherapeutic treatment of weight-related health problems
- Weight-enhancing drugs
- Drugs that promote weight loss (eg, antiobesity drugs)
- Weight-enhancing health problems that are not yet treated
- Cancerous disease within the last 5 years
- Current substance-use disorders, major depression, psychosis, suicidal tendency, or pregnancy
- Severe cognitive impairments
- Insufficient knowledge of the German language
- Binge-eating disorder or bulimia nervosa

Intervention Phase

Participants in the intervention group received a 12-week tailored app intervention. In the first week of intervention, the introduction module was unlocked for each participant, followed by 9 weeks of tailored intervention comprising 3 of the 5 main modules. Each session of the 3 main modules was unlocked successively between weeks 2 and 9. The basic, minimal content of the remaining 2 modules was provided in the form of mini modules, which were unlocked in week 11. Finally, the conclusion module was provided to each participant in week 12.

Tailoring

Figure 2 displays computer-based and self-tailoring features of the intervention. The introduction and conclusion module were mandatory elements framing the intervention that conveyed general content, whereas the main modules targeted individual

differences in weight-related psychological parameters. The main module assignment was computer-based and depended on the results of the Revised Illness Perception Questionnaire (IPQ-R), a standardized questionnaire adapted to overweight and obesity that measures illness beliefs (eg, "my overweight strongly affects the way others see me") and causal attribution of overweight (eg, "my emotional state, e.g. feeling down, lonely, anxious, empty") [79]. Participants completed the IPQ-R at the baseline assessment. Each of the 32 items were rated on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). In this study, the internal consistency of the scale was good (Cronbach α=.714). Scales were regenerated with higher means representing severe problems on the related psychological parameters associated with overweight and obesity (eg, EE). Of the 5 dimensions, 3 on which the participants reported the highest impairments were tailored to the participants (computer-based tailoring). In addition to the computer-based tailoring feature, individual adaption of content and functions was enabled (self-tailoring). Each module was presented in either a men-specific (*version B*) or a women-specific version (*version A*; "App features" section and Multimedia Appendix 1). The app additionally contained customization features to enhance the adherence to the intervention [80]. In particular, the participants could choose between different coaches at the beginning of the 12-week intervention. A total of 4 different coaches were introduced: 2 men and 2 women coaches depicted as being either more friendly (eg, informal and motivating tips) or more professional (eg, formal and directive tips).

Figure 2. Tailoring features of the I-GENDO intervention. Of the 5 main modules (in the box), 3 were assigned to the participants based on the results of the revised illness perception questionnaire (computer-based tailoring). Each of the modules was presented in either a women- or men-targeted version (self-tailoring).

Measurements

Engagement With the App

Use patterns were retrieved from individual app data and subsequently analyzed. Actions were defined as time slots of active engagement with the app, for example, log-in to the app and processing a session (use frequency). Inactivity for 20 minutes defined the completion of one action. The overall app use time was calculated in minutes (use time). The participants who used the app at least 12 times (actions) and for 120 minutes within the 12-week intervention were defined as being compliant with the I-GENDO app.

Satisfaction With the App

At the end of the conclusion module, the users could give feedback about their satisfaction with the app and the relevance and daily usefulness of the app on scales ranging from 0 ("not at all") to 100 ("very much"). In the last session of each module, participants could evaluate how satisfied they were with the corresponding module.

Usability Rating of the App

After the 12-week intervention, the mHealth App Usability Questionnaire for stand-alone mHealth apps used by patients was administered [81]. The original English questionnaire was translated into German by a member of the research group and retranslated by a native speaker. Deviations were discussed and subsequently adjusted. The self-report questionnaire consisted of 18 items, which were scored on a scale from 1 ("strongly disagree") to 7 ("strongly agree"), with higher means reflecting higher usability. Prior research indicated good psychometric properties of the English version of the mHealth App Usability Questionnaire [81]. In this study, the internal consistency of the total scale was excellent (Cronbach α=.935).

Data Analysis

All analyses were conducted using SPSS for Windows (version 26.0; IBM Corp) and Excel (version 16.0; Microsoft Corp). App data were retrieved from Apache CouchDBTM. Descriptive analyses were conducted using percentages and frequencies for categorical variables and means and SDs for continuous variables. *Chi-square* distributions that compared categorical variables between genders were implemented, and Bonferroni-adjusted independent 2-tailed *t* tests were conducted to compare metrically scaled variables. Mann-Whitney *U* tests were conducted to compare results between genders on nonnormally-distributed variables. Friedman tests and Dunn-Bonferroni post hoc tests were implemented to compare app engagement between genders over the 12 weeks of intervention.

Results

Participants

We found no significant gender differences in age, BMI, marital status, and education level at baseline (Table 1).

Table 1. Sociodemographic factors (N=116).

Characteristic	Overall	Women (n=77)	Men (n=39)	Women vs men		
			2-tailed t test (*df*)	Chi-square (*df*)	*P* value[a]
Age (years), mean (SD)	47.28 (11.66)	46.40 (12.22)	49.00 (10.38)	1.14 (114)	N/A[b]	.26
BMI (kg/m^2), mean (SD)	33.58 (3.79)	33.75 (3.69)	33.23 (4.02)	0.70 (114)	N/A	.49
Marital status (yes), n (%)[c]	91 (78.4)	57 (74)	34 (87)	N/A	1.9 (1)	.17
Education (university), n (%)[d]	36 (31)	25 (32)	11 (28)	N/A	0.1 (1)	.80

[a]Bonferroni-adjusted *P* values.

[b]N/A: not applicable.

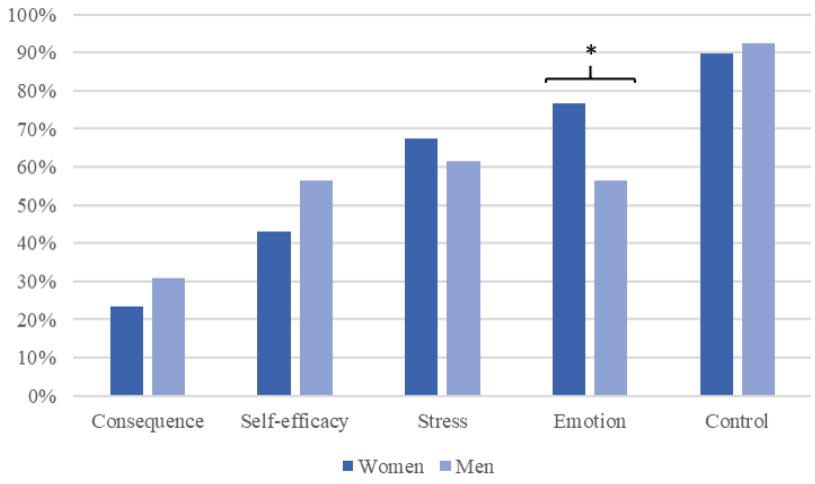
[c]Number of participants in a relationship.

[d]Number of participants with a university degree.

Tailoring

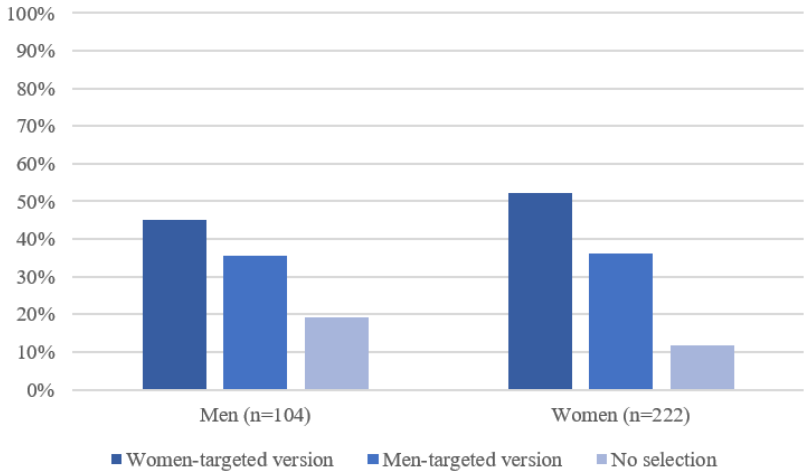
Three main modules were tailored to each of the 116 participants by computer-based tailoring according to their IPQ-R results (see the section *Tailoring*). Most participants (105/116, 90.5%) received the *control module*, followed by the *emotion module* (81/116, 69.8%), *stress module* (76/116, 65.5%), and *self-efficacy module* (55/116, 47.4%). One-quarter of the participants (30/116, 25.9%) received the *consequence module*. Figure 3 illustrates the module assignments for the participating men and women separately. Significantly more women obtained the *emotion module* than men (χ^2_1=4.1; *P*=.04; ϕ=0.21). The genders did not differ in the assignment of the *consequence* (χ^2_1=0.4; *P*=.53), *self-efficacy* (χ^2_1=1.6; *P*=.23), *stress* (χ^2_1=0.2; *P*=.66), or *control module* (χ^2_1=0.02; *P*=.89).

Figure 3. Assigned full-version modules (computer-based tailoring) in percentage (**P*<.005).



As described earlier, at the beginning of each module, the participants were instructed to choose between either a women-targeted or a men-targeted version (self-tailoring). In 50% (163/326) of the choices, the women-targeted versions were selected (women: 116/222, 52.3%; men: 47/104, 45.2%). In 35.9% (117/326) of the choices, the men-targeted versions were selected (women: 80/222, 36%; men: 37/104, 35.6%). In the remaining 14.1% (46/326) of the choices, no selection was made (Figure 4). When the participants did choose a version, they chose version A 58.2% (163/280) of the time (women: 116/196, 59.2%; men: 47/84, 56%).

Figure 4. Module version assignments (self-tailoring) in percentage (total choices: N=326).



Another customization feature of the intervention was the selection of an accompanying coach when starting the app for the first time. Most women (35/74, 47%) chose a friendly woman coach, 19% (14/74) chose a professional man coach, 18% (13/74) chose a friendly man coach, and 16% (12/74) chose a professional woman coach. Coach assessment in men was more balanced, with 34% (12/35) choosing a friendly woman coach, 23% (8/35) choosing a friendly man or professional woman coach, and 20% (7/35) choosing a professional man coach. No significant gender differences were found in coach assessment (χ^2_3=1.9; *P*=.60).

Engagement With the App

Of the 116 participants in the intervention group, 109 actively participated in the app intervention phase. During the 12-week intervention period, the use frequency and use time were recorded.

We found significant gender difference in use frequency (*U*=908.00; *z* score=−2.51; *P*=.01; *r*=−0.24) and use time (*U*=736.00; *z* score=−3.63; *P*<.001; *r*=−0.35). The participating women used the app 97 (SD 88.03) times and for 625 (SD 427.94) minutes on average throughout the intervention, whereas the participating men used the app 56 (SD 45.62) times and for 347 (SD 285.68) minutes on average. In total, 82.6% (90/109) of the users were compliant with the app (women: 63/74, 85%; men: 27/35, 77%).

During the 12-week intervention phase, the use time (χ^2_{11}=126.03; *P*<.001) and use frequency (χ^2_{11}=139.51; *P*<.001) of the participating men (n=35) decreased (Figures 5 and 6). The use time, (χ^2_{11}=231.34; *P*<.001) and use frequency (χ^2_{11}=309.16; *P*<.001) of the participating women (n=74) also decreased. Dunn-Bonferroni post hoc tests revealed a significant decrease in use time within the first 3 weeks of intervention (*z* score=3.99; *P*<.001; *r*=0.46). From week 3 to week 12, use time and frequency leveled off at approximately 6.56 (SD 7.21) actions per week and 41.99 (SD 34.03) minutes per week for the participating women and 3.53 actions per week (SD 3.36) and 21.75 minutes per week (SD 21.88) for the participating men. We found no gender differences in use time progress (*U*=1075.00; *z* score=−1.43; *P*=.15) and use frequency progress (*U*=1106.00, *z* score=−1.23; *P*=.22) during the 12-week intervention period.

Figure 5. Use time per week in minutes (means and SEs of means).

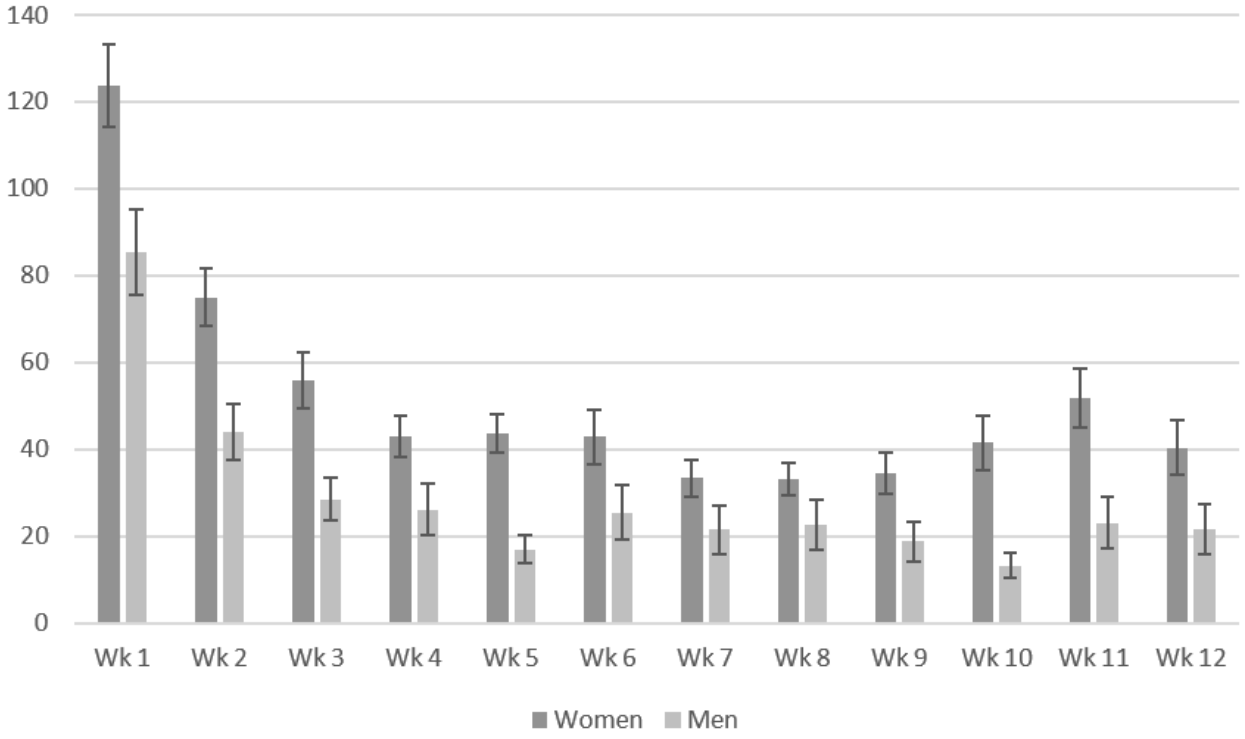
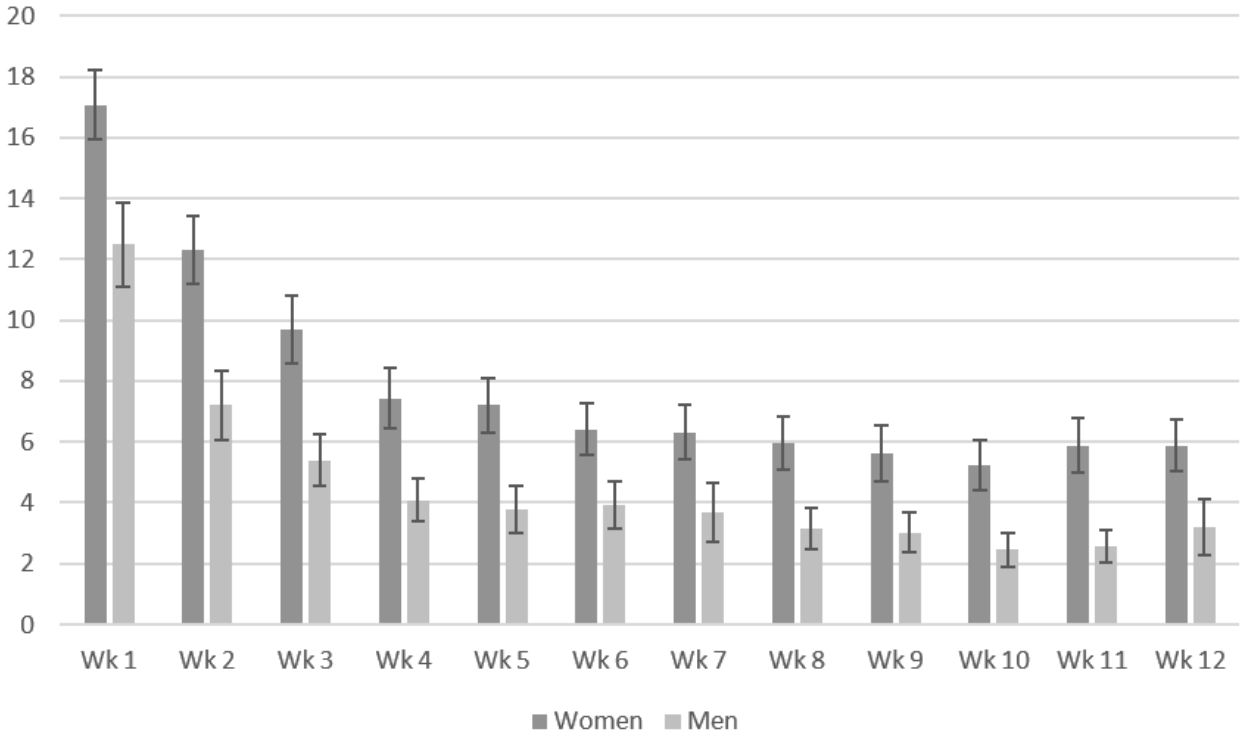


Figure 6. Use frequency per week in actions (means and SEs of means).



Evaluation of the App

After completion, 41 participants evaluated the I-GENDO app. On average, the overall satisfaction with the app was high (mean 85.54, SD 19.36). In addition, the relevance of the content (mean 83.34, SD 20.03) and daily life usefulness (mean 78.95, SD 22.24) were evaluated as satisfactory. Of the main modules, the *stress module* (n=36) was rated best (mean 82.92, SD 14.05), followed by the *emotion module* (n=50; mean 81.66, SD 16.45), the *control module* (n=60; mean 80.47, SD 18.08), the *self-efficacy module* (n=29; mean 78.48, SD 17.66), and finally the *consequence module* (n=16; mean 67.75, SD 21.68).

In addition to the evaluation, the usability of the app was assessed using a standardized questionnaire (see the section *Usability Rating of the App*). The usability of the app was rated, on average, with 71% satisfaction (mean 5.00, SD 1.08 points; maximum: 7.00 points). No gender differences could be found between the usability ratings of men (mean 4.72, SD 1.07) and women (mean 5.13, SD 1.07; t_{99}=−1.76; *P*=.08).

Discussion

Overview

We aimed to introduce the I-GENDO app, a tailored gender-sensitive mHealth weight loss intervention, and present results from its process evaluation data. Therefore, data from the intervention arm of the I-GENDO project were analyzed. The sample included 116 (n=77, 66.4% women) individuals with overweight and obesity.

Principal Findings

We developed a module-based 12-week intervention combining computer-based and self-tailoring features. Most participants (105/116, 90.5%) received the *control module*, which focused on self-regulation skills of food craving. The *stress module* was assigned to 65.5% (76/116) of the participants, and the *self-efficacy module* to 47.4% (55/116). The *consequence module* was obtained by 25.9% (30/116) of the participants. Significantly more women (59/77, 77%) than men (22/39, 56%) received the *emotion module*. Another tool of the intervention was the implementation of gender-sensitive self-tailoring features. We developed women- and men-targeted versions of the main modules. At the beginning of each module, participants could choose between the 2 versions. Among the participants who chose a version, *version A* was chosen 58.2% (163/280) of the time (women: 116/196, 59.2%; men: 47/84, 56%), which means that among both genders, the women-targeted module versions were predominantly selected.

In total, 82.6% (90/109) of the participants (women: 63/74, 85%; men: 27/35, 77%) were compliant with the I-GENDO app during the intervention phase. Use time and frequency significantly decreased during the 12-week intervention phase for both genders. After the first 3 weeks of intervention, use time leveled off and remained stable at approximately 42 minutes per week for the participating women and 22 minutes per week for the participating men. Similarly, use frequencies were approximately stable as of week 3 for both genders. Compared with the women, the men used the app infrequently and spent less time with the app. Nevertheless, the average use times and frequencies in both genders were satisfactory even in the last weeks.

The overall satisfaction with the app was high, with almost 86% (86/100) approval. In addition, the daily life usefulness and relevance of the content were ranked satisfactory by 79% (79/100) and 83% (83/100) of participants, respectively. The highest-rated main module was the *stress module* (83/100, 83%), but even the satisfaction with the *consequence module* was acceptable (68/100, 68%). In general, the usability ratings indicated that the I-GENDO intervention was good, averaging 5.0 out of 7.0 points (71%).

Comparison With Prior Work

The heterogeneous computer-based administration of the main modules supports the tailoring feature. The *control module* was assigned to most participants. This is in line with the observation that decreased food-related inhibitory control is regularly associated with overweight and obesity [49,82,83]. Gender differences were found in the computer-based assignments of the *emotion module*, which significantly more women obtained. The module focused on dysfunctional emotion regulation and associations between negative emotions and (eating) behavior. EE refers to problems in the distinction between physiological appetite and eating as a strategy to cope with negative feelings [84]. EE is correlated with higher weight, severe depression symptoms, and the consumption of sweet energy-dense foods [85]. More women report negative emotions as causes for their overweight and engage more often in EE compared with men [50,85,86]. EE is associated with less intuitive eating by women, which could be a barrier to the implementation of healthy eating behaviors [87]. Studies indicate that more women undergo weight loss treatment, whereas participating men lose more absolute weight [29]. Focusing more on EE in treatment might contribute to a close in this gap. In addition, previous studies indicated that a relevant subgroup of individuals with overweight and obesity exhibit addiction-like eating behavior (ie, food addiction [FA]), characterized by an impaired food-related inhibitory control, EE, and food craving [88,89]. The prevalence of FA is higher in women than in men and is among other factors associated with higher BMI, dysfunctional eating behavior, and psychological distress [90,91]. Some studies reported lower adherence to and decreased effectiveness of WLPs in individuals experiencing FA, whereas others found no influence of FA on the success of WLPs [92-95]. As the *control* and *emotion* modules implement the treatment of dysfunctional EE behavior and exercises to improve food-related inhibitory control, participants experiencing FA might especially benefit from the intervention. Thus, the association between FA and the effectiveness of our intervention should be further investigated.

One-quarter of the participants received the *consequences module*, which focused on weight-related discrimination and the improvement of self-esteem and body image, as well as the social competences to deal with discrimination. The extent of this use might explain the prevalence of weight discrimination being higher in our sample than in the results of a representative German study reporting prevalence rates ranging from 5.6% to 18.7% in individuals with overweight and obesity (classes I and II) [96]. We hypothesized that individuals who have experienced discrimination might prefer seeking WLPs based on psychological rather than lifestyle features. Moreover, in our study, the *consequence module* was assigned to more men (12/39, 31%) than women (18/77, 23%), which appears to be in contrast to the results of the previously cited study that reported double the prevalence of weight-based discrimination in women [96]. The anonymity of a smartphone-based intervention combined with the opportunity to receive specialized psychological support targeted to individual needs could have been particularly appealing for men who had experienced weight-related discrimination and were affected by the consequences of their overweight. Nevertheless, the

module generally focused on weight-related emotional and physical consequences, which might be appealing to individuals with overweight and obesity regardless of whether they experienced discrimination.

Gender differences in health care services are an important consideration for the improvement of treatment outcomes [97]. Prior studies have indicated gender differences in eating behavior, as well as the psychological factors associated with weight gain and maintenance, highlighting the need for gender-targeted weight loss interventions [29,40]. As the effectiveness of gender dichotomous tailoring does not significantly differ from that of gender-neutral interventions [45], we implemented gender-sensitive self-tailoring features. The participants could choose between 2 gender-targeted versions at the beginning of the modules. The selection of the versions was heterogeneous, with most participants choosing women-targeted versions. This result supports the idea of gender-sensitive interventions to overcome gender binary [46]. However, its influence on the effectiveness of the intervention needs to be further investigated.

In complex digital interventions, the consideration of relevant process evaluation data (eg, usability testing and use patterns) is crucial before interpreting the effectiveness of the intervention [98]. The compliance with the app was satisfactory (90/109, 82.6%) and comparable with other studies. Signal et al [99] developed an eHealth intervention for prediabetes and diabetes self-management. They reported that 74% of the participants were actively engaged (ie, any use data were detected at any time throughout the 16-week intervention). Ruf et al [100] developed an mHealth intervention that assesses event-contingent dietary intake and physical activity, as well as relevant psychological parameters. Compliance, defined as the percentage of complete prompts within the total number of prompts received, was 80%. Another mHealth intervention focused on the management of food-related impulses to facilitate weight loss [101]. In that study, the completion rate (the number of participants who provided data at the 3-month follow-up) was 76%. These findings suggest that our compliance rate is comparable or even higher, although the differences in operational definitions cloud the interpretation.

Throughout the intervention, the use time and frequency decreased in both genders. Decreases in engagement were also reported in other studies; that is, in those with extended intervention periods [99,102]. Reductions in engagement and high dropouts are typical for internet-based interventions and are caused by a variety of reasons [103]. We hypothesized that the reduction in engagement observed in our study might be associated with the high number of competing commercial digital weight loss interventions, which might be less demanding, compared with psychological interventions. Moreover, the intervention phase of our study fell within the first and second lockdowns of the COVID-19 pandemic in Germany in 2020. During this period, the level of psychological distress increased, and vulnerable people engaged more often in dysfunctional eating patterns (ie, EE) [104]. In addition, many people were affected by short-term work or job losses and subsequent income losses [105]. It is likely that people neglected the intervention during this burdensome period.

The results from previous studies on the adherence to mHealth interventions are heterogeneous, with some reporting higher engagement in men [29,40,106] and others reporting higher engagement in women [99]. In our study, women used the app more frequently and spent more time on it. In the general German population, women report higher smartphone use time (mean 167 min/day) than men (mean 154 min/day), which might at least partially explain these differences [107]. Moreover, women are more interested in body appearance and health-related topics than men and use the internet more frequently for medical and health research [108-110]. Studies have also reported that women are more likely to use mHealth interventions focusing on nutrition and self-care apps, whereas men are more likely to use fitness apps [111-113]. Therefore, the lower engagement of the participating men in this study might be because the app focused on psychological rather than physiological determinants of overweight and obesity.

As reported in a recently published systematic review [114], other studies on mHealth interventions have either failed to report gender differences in the adherence to and usability of these interventions or reported results from biased samples with approximately 90% of women [115-117]. Given that higher engagement in mHealth interventions is usually associated with better outcomes [22,24,118], we propose that the samples in future studies should be more balanced with regard to gender and implement gender-sensitive feasibility and usability testing. Overall, the compliance with the app (90/109, 82.6%) and satisfaction with the app (86/100, 86%) were high and comparable with those of other mHealth interventions [99-101,119]. The usability of the app was rated with 71% (5.0/7.0 points) satisfaction. Other evidence-based mHealth weight loss interventions reported comparable or even lower usability scores, between 61.9% and 69.3% [100,119]. In addition, Ferrara et al [120] reviewed the usability of commercial weight loss apps, which can be downloaded from Google Play and the Apple Store. Scientists ranked the usability of these apps between 47% and 89%.

Limitations

In our study, men and women differed in the assignment of main modules, which focused on psychological parameters associated with the development and maintenance of overweight and obesity. Interestingly, most men and women selected the women-targeted versions of the main modules. Given that the participants were blind to the gender-targeted manipulation, we suggest that the selections were not influenced by social desirability. Future studies should distinguish between gender differences based on the results from explicit and implicit assessments to adjust for social norms. Moreover, the participants were forced to select one version at the beginning of each module and were not allowed to switch versions. A reasonable approach could be to allow participants to test both versions to enhance their adherence to the app. In addition, it should be verified whether the introductions of the versions sufficiently hint at different module content.

It should be noted that only few participants (41/109, 37.6%) evaluated the app after completion. The evaluation was voluntary and was assessed at the end of the last session of the

intervention. Therefore, results regarding satisfaction with the app and the main modules should be interpreted cautiously.

The results from the process evaluation revealed that men and women differed in their app use. Women used the app more frequently and longer than men. Most of the scientists involved in the development process were women. Therefore, the women-targeted features of the app might have been more salient and thus confounded the selection by both genders. This methodological aspect might subsequently explain the higher use patterns of the participating women. Future studies or revisions of the app intervention should involve men scientists.

Conclusions

In summary, given the high diversity in module assignment, we hypothesize that tailoring was successfully implemented in the intervention. The heterogeneous selection of the gender-targeted features might underscore the need for gender-sensitive (self-tailoring and blind choice) instead of gender dichotomous (computer-based tailoring) targeting but could also hint at methodological limitations, which need to be considered and further investigated in future studies. Further studies need to clarify whether the reported gender differences in the use and evaluation of the app confound the effectiveness and sustainability of the I-GENDO intervention.

Acknowledgments

The Federal Ministry of Education and Research, Germany funded this study. The authors would like to acknowledge support from the Open Access Publication Funds of the Ruhr-Universität Bochum. The authors would also like to acknowledge Zoé Blumenwitz for research assistance.

Authors' Contributions

MP was involved in conceptualization, the acquisition of data, formal analysis, the interpretation of data, and the writing of the original draft. TF was involved in the acquisition and interpretation of data, review, and editing. CS and TR were involved in the acquisition of data, review, and editing. SS contributed to the study design. JW and SH contributed to the study design, supervision, review, and editing. SS-L contributed to the study design, conceptualization, study supervision, review, and editing.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Evidence, content, and adaptions of the gender-sensitive main modules.
[DOCX File , 55 KB-Multimedia Appendix 1]

References

1. World Health Organization. mHealth: mHealth: New horizons for health through mobile technologies. Geneva: World Health Organization; 2011.
2. Gesundheit digital. Perspektiven zur Digitalisierung im Gesundheitswesen. Book in German. Cham: Springer; 2019.
3. Webster P. Virtual health care in the era of COVID-19. Lancet 2020 Apr;395(10231):1180-1181. [doi: 10.1016/s0140-6736(20)30818-7]
4. D21 Digital Index 2020/2021. Initiative D21. 2013. URL: https://initiatived21.de/app/uploads/2021/02/d21-digital-index-2020_2021.pdf [accessed 2022-03-28]
5. Farley H. Promoting self-efficacy in patients with chronic disease beyond traditional education: a literature review. Nurs Open 2020 Jan 20;7(1):30-41 [FREE Full text] [doi: 10.1002/nop2.382] [Medline: 31871689]
6. Krebs P, Prochaska JO, Rossi JS. A meta-analysis of computer-tailored interventions for health behavior change. Prev Med 2010;51(3-4):214-221 [FREE Full text] [doi: 10.1016/j.ypmed.2010.06.004] [Medline: 20558196]
7. Stephens J, Allen J. Mobile phone interventions to increase physical activity and reduce weight: a systematic review. J Cardiovasc Nurs 2013;28(4):320-329 [FREE Full text] [doi: 10.1097/JCN.0b013e318250a3e7] [Medline: 22635061]
8. Patel B, Thind A. Usability of mobile health apps for postoperative care: systematic review. JMIR Perioper Med 2020 Jul 20;3(2):e19099 [FREE Full text] [doi: 10.2196/19099] [Medline: 33393925]
9. Turner-McGrievy GM, Beets MW, Moore JB, Kaczynski AT, Barr-Anderson DJ, Tate DF. Comparison of traditional versus mobile app self-monitoring of physical activity and dietary intake among overweight adults participating in an mHealth weight loss program. J Am Med Inform Assoc 2013 May 01;20(3):513-518 [FREE Full text] [doi: 10.1136/amiajnl-2012-001510] [Medline: 23429637]
10. Alnasser A, Kyle J, Aloumi N, Al-Khalifa A, Marais D. The Twazon Arabic weight loss app: app-based intervention for Saudi women with obesity. JMIR Mhealth Uhealth 2019 May 28;7(5):e10923 [FREE Full text] [doi: 10.2196/10923] [Medline: 31140444]
11. Cavero-Redondo I, Martinez-Vizcaino V, Fernandez-Rodriguez R, Saz-Lara A, Pascual-Morena C, Álvarez-Bueno C. Effect of behavioral weight management interventions using lifestyle mHealth self-monitoring on weight loss: a systematic

review and meta-analysis. Nutrients 2020 Jul 03;12(7):1977 [FREE Full text] [doi: 10.3390/nu12071977] [Medline: 32635174]
12. Jeffery RW, Epstein LH, Wilson GT, Drewnowski A, Stunkard AJ, Wing RR. Long-term maintenance of weight loss: current status. Health Psychol 2000 Jan;19(1, Suppl):5-16. [doi: 10.1037/0278-6133.19.Suppl1.5]
13. Beleigoli AM, Andrade AQ, Cançado AG, Paulo MN, Diniz MD, Ribeiro AL. Web-based digital health interventions for weight loss and lifestyle habit changes in overweight and obese adults: systematic review and meta-analysis. J Med Internet Res 2019 Jan 08;21(1):e298 [FREE Full text] [doi: 10.2196/jmir.9609] [Medline: 30622090]
14. Gudzune KA, Doshi RS, Mehta AK, Chaudhry ZW, Jacobs DK, Vakil RM, et al. Efficacy of commercial weight-loss programs. Ann Intern Med 2015 Apr 07;162(7):501-512. [doi: 10.7326/m14-2238]
15. Pagoto S, Schneider K, Jojic M, DeBiasse M, Mann D. Evidence-based strategies in weight-loss mobile apps. Am J Prev Med 2013 Nov;45(5):576-582. [doi: 10.1016/j.amepre.2013.04.025] [Medline: 24139770]
16. National Clinical Guideline Centre (UK). Obesity: Identification, Assessment and Management of Overweight and Obesity in Children, Young People and Adults. London: National Institute for Health and Care Excellence (NICE); Nov 2014.
17. Hauner H, Moss A, Berg A, Bischoff SC, Colombo-Benkmann M, Ellrott T, et al. Interdisziplinäre Leitlinie der Qualität S3 zur "Prävention und Therapie der Adipositas". Article in Gerrman. Adipositas Ursachen Folgeerkrankungen Therapie 2017 Dec 21;08(04):179-221. [doi: 10.1055/s-0037-1618857]
18. Davis A, Sweigart R, Ellis R. A systematic review of tailored mHealth interventions for physical activity promotion among adults. Transl Behav Med 2020 Oct 12;10(5):1221-1232. [doi: 10.1093/tbm/ibz190] [Medline: 33044542]
19. Ryan K, Dockray S, Linehan C. A systematic review of tailored eHealth interventions for weight loss. Digit Health 2019;5:2055207619826685 [FREE Full text] [doi: 10.1177/2055207619826685] [Medline: 30783535]
20. DiClemente R, Nowara A, Shelton R, Wingood G. Need for innovation in public health research. Am J Public Health 2019 Feb;109(S2):S117-S120. [doi: 10.2105/AJPH.2018.304876] [Medline: 30785791]
21. Noar SM, Grant Harrington N, Van Stee SK, Shemanski Aldrich R. Tailored health communication to change lifestyle behaviors. Am J Lifestyle Med 2010 Nov 19;5(2):112-122. [doi: 10.1177/1559827610387255]
22. Puls H, Schmidt R, Herpertz S, Zipfel S, Tuschen-Caffier B, Friederich H, et al. Adherence as a predictor of dropout in Internet-based guided self-help for adults with binge-eating disorder and overweight or obesity. Int J Eat Disord 2020 Apr 31;53(4):555-563. [doi: 10.1002/eat.23220] [Medline: 31891225]
23. Butryn ML, Godfrey KM, Martinelli MK, Roberts SR, Forman EM, Zhang F. Digital self-monitoring: does adherence or association with outcomes differ by self-monitoring target? Obes Sci Pract 2020 Apr;6(2):126-133 [FREE Full text] [doi: 10.1002/osp4.391] [Medline: 32313670]
24. Calugi S, Marchesini G, El Ghoch M, Gavasso I, Dalle Grave R. The association between weight maintenance and session-by-session diet adherence, weight loss and weight-loss satisfaction. Eat Weight Disord 2020 Feb 21;25(1):127-133. [doi: 10.1007/s40519-018-0528-8] [Medline: 29931447]
25. Neve M, Morgan PJ, Jones PR, Collins CE. Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: a systematic review with meta-analysis. Obes Rev 2010 Apr;11(4):306-321. [doi: 10.1111/j.1467-789X.2009.00646.x] [Medline: 19754633]
26. Schvey NA, Puhl RM, Brownell KD. The impact of weight stigma on caloric consumption. Obesity (Silver Spring) 2011 Oct;19(10):1957-1962 [FREE Full text] [doi: 10.1038/oby.2011.204] [Medline: 21760636]
27. Tomiyama AJ. Weight stigma is stressful. A review of evidence for the Cyclic Obesity/Weight-Based Stigma model. Appetite 2014 Nov;82:8-15. [doi: 10.1016/j.appet.2014.06.108] [Medline: 24997407]
28. van Strien T. Causes of emotional eating and matched treatment of obesity. Curr Diab Rep 2018 Apr 25;18(6):35 [FREE Full text] [doi: 10.1007/s11892-018-1000-x] [Medline: 29696418]
29. Tsai SA, Lv N, Xiao L, Ma J. Gender differences in weight-related attitudes and behaviors among overweight and obese adults in the United States. Am J Mens Health 2016 Sep 22;10(5):389-398 [FREE Full text] [doi: 10.1177/1557988314567223] [Medline: 25595019]
30. Koritzky G, Yechiam E, Bukay I, Milman U. Obesity and risk taking. A male phenomenon. Appetite 2012 Oct;59(2):289-297. [doi: 10.1016/j.appet.2012.05.020] [Medline: 22634199]
31. Mensink G, Schienkiewitz A, Haftenberger M, Lampert T, Ziese T, Scheidt-Nave C. Overweight and obesity in Germany: results of the German Health Interview and Examination Survey for Adults (DEGS1). Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2013 May;56(5-6):786-794 [FREE Full text] [doi: 10.1007/s00103-012-1656-3] [Medline: 23703499]
32. Schienkiewitz A, Mensink G, Kuhnert R, Lange C. Overweight and obesity among adults in Germany. J Health Monitoring 2017 Jun 15;2:20-27 [FREE Full text] [doi: 10.17886/RKI-GBE-2017-038]
33. Kiefer I, Rathmanner T, Kunze M. Eating and dieting differences in men and women. J Men's Health Gender 2005 Jun;2(2):194-201. [doi: 10.1016/j.jmhg.2005.04.010]
34. Anbumalar C, Dorathy Agines P, Jaswanti VP, Priya D, Reniangelin D. Gender differences in perceived stress levels and coping strategies among college students. Int J Indian Psychol 2017 Sep 25;4(4). [doi: 10.25215/0404.103]
35. Tamres LK, Janicki D, Helgeson VS. Sex differences in coping behavior: a meta-analytic review and an examination of relative coping. Pers Soc Psychol Rev 2016 Dec 21;6(1):2-30. [doi: 10.1207/s15327957pspr0601_1]

36. Rütten A, Abu-Omar K. Prevalence of physical activity in the European Union. Soz Praventivmed 2004 Aug;49(4):281-289. [doi: 10.1007/s00038-004-3100-4] [Medline: 15357531]
37. Novelle MG, Diéguez C. Updating gender differences in the control of homeostatic and hedonic food intake: implications for binge eating disorder. Mol Cell Endocrinol 2019 Nov 01;497:110508. [doi: 10.1016/j.mce.2019.110508] [Medline: 31319096]
38. Frank AP, de Souza Santos R, Palmer BF, Clegg DJ. Determinants of body fat distribution in humans may provide insight about obesity-related health risks. J Lipid Res 2019 Oct;60(10):1710-1719. [doi: 10.1194/jlr.r086975]
39. Kroll DS, Feldman DE, Biesecker CL, McPherson KL, Manza P, Joseph PV, et al. Neuroimaging of sex/gender differences in obesity: a review of structure, function, and neurotransmission. Nutrients 2020 Jun 30;12(7):1942 [FREE Full text] [doi: 10.3390/nu12071942] [Medline: 32629783]
40. Cooper AJ, Gupta SR, Moustafa AF, Chao AM. Sex/gender differences in obesity prevalence, comorbidities, and treatment. Curr Obes Rep 2021 Dec 02;10(4):458-466. [doi: 10.1007/s13679-021-00453-x] [Medline: 34599745]
41. Chin SO, Keum C, Woo J, Park J, Choi HJ, Woo J, et al. Successful weight reduction and maintenance by using a smartphone application in those with overweight and obesity. Sci Rep 2016 Nov 07;6:34563 [FREE Full text] [doi: 10.1038/srep34563] [Medline: 27819345]
42. Klenk S, Reifegerste D, Renatus R. Gender differences in gratifications from fitness app use and implications for health interventions. Mobile Media Commun 2017 Mar 01;5(2):178-193. [doi: 10.1177/2050157917691557]
43. Greenberg I, Stampfer MJ, Schwarzfuchs D, Shai I, DIRECT Group. Adherence and success in long-term weight loss diets: the dietary intervention randomized controlled trial (DIRECT). J Am Coll Nutr 2009 Apr;28(2):159-168. [doi: 10.1080/07315724.2009.10719767] [Medline: 19828901]
44. Bautista-Castaño I, Molina-Cabrillana J, Montoya-Alonso JA, Serra-Majem L. Variables predictive of adherence to diet and physical activity recommendations in the treatment of obesity and overweight, in a group of Spanish subjects. Int J Obes Relat Metab Disord 2004 May 2;28(5):697-705. [doi: 10.1038/sj.ijo.0802602] [Medline: 14993911]
45. Sharkey T, Whatnall MC, Hutchesson MJ, Haslam RL, Bezzina A, Collins CE, et al. Correction to: effectiveness of gender-targeted versus gender-neutral interventions aimed at improving dietary intake, physical activity and/or overweight/obesity in young adults (aged 17-35 years): a systematic review and meta-analysis. Nutr J 2020 Aug 26;19(1):90 [FREE Full text] [doi: 10.1186/s12937-020-00605-0] [Medline: 32847592]
46. Hyde JS, Bigler RS, Joel D, Tate CC, van Anders SM. The future of sex and gender in psychology: five challenges to the gender binary. Am Psychol 2019 Feb;74(2):171-193. [doi: 10.1037/amp0000307] [Medline: 30024214]
47. I-GENDO study. Universitat Bamberg. 2022. URL: https://www.uni-bamberg.de/klinpsych/forschung/projekte/i-gendo [accessed 2022-03-29]
48. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. Ann Behav Med 2013 Aug 20;46(1):81-95. [doi: 10.1007/s12160-013-9486-6] [Medline: 23512568]
49. Houben K, Nederkoorn C, Jansen A. Eating on impulse: the relation between overweight and food-specific inhibitory control. Obesity (Silver Spring) 2014 May 09;22(5):E6-E8 [FREE Full text] [doi: 10.1002/oby.20670] [Medline: 24910860]
50. Larsen JK, van Strien T, Eisinga R, Engels RC. Gender differences in the association between alexithymia and emotional eating in obese individuals. J Psychosom Res 2006 Mar;60(3):237-243. [doi: 10.1016/j.jpsychores.2005.07.006] [Medline: 16516654]
51. Dallman MF, Pecoraro N, Akana SF, La Fleur SE, Gomez F, Houshyar H, et al. Chronic stress and obesity: a new view of "comfort food". Proc Natl Acad Sci U S A 2003 Sep 30;100(20):11696-11701 [FREE Full text] [doi: 10.1073/pnas.1934666100] [Medline: 12975524]
52. Sinha R, Jastreboff AM. Stress as a common risk factor for obesity and addiction. Biol Psychiatry 2013 May 01;73(9):827-835 [FREE Full text] [doi: 10.1016/j.biopsych.2013.01.032] [Medline: 23541000]
53. Barry D, Petry N. Gender differences in associations between stressful life events and body mass index. Prev Med 2008 Nov;47(5):498-503 [FREE Full text] [doi: 10.1016/j.ypmed.2008.08.006] [Medline: 18793665]
54. Bennett E, Gough B. In pursuit of leanness: the management of appearance, affect and masculinities within a men's weight loss forum. Health (London) 2013 May;17(3):284-299 [FREE Full text] [doi: 10.1177/1363459312454149] [Medline: 22815334]
55. Galdas P, Darwin Z, Kidd L, Blickem C, McPherson K, Hunt K, et al. The accessibility and acceptability of self-management support interventions for men with long term conditions: a systematic review and meta-synthesis of qualitative studies. BMC Public Health 2014 Nov 27;14(1):1230-1296 [FREE Full text] [doi: 10.1186/1471-2458-14-1230] [Medline: 25428230]
56. Robertson C, Archibald D, Avenell A, Douglas F, Hoddinott P, van Teijlingen E, et al. Systematic reviews of and integrated report on the quantitative, qualitative and economic evidence base for the management of obesity in men. Health Technol Assess 2014 May;18(35):v-vi, xxiii [FREE Full text] [doi: 10.3310/hta18350] [Medline: 24857516]
57. Becker S, Zipfel S, Teufel M. Psychotherapie der Adipositas: Interdisziplinäre Diagnostik und differenzielle Therapie. Stuttgart, Germany: Kohlhammer Verlag; 2015.
58. Cooper Z, Fairburn CG. A new cognitive behavioural approach to the treatment of obesity. Behav Res Ther 2001 May 01;39(5):499-511. [doi: 10.1016/s0005-7967(00)00065-6] [Medline: 28465183]

59. Kaluza G. Stressbewältigung: Trainingsmanual zur psychologischen Gesundheitsförderung. Berlin, Germany: Springer-Verlag; 2018.
60. Kaluza G. Gelassen und sicher im Stress-Das Stresskompetenz-Buch. Berlin, Heidelberg: Springer; 2018.
61. Bennett J, Greene G, Schwartz-Barcott D. Perceptions of emotional eating behavior. A qualitative study of college students. Appetite 2013 Jan;60(1):187-192. [doi: 10.1016/j.appet.2012.09.023] [Medline: 23046706]
62. Nolen-Hoeksema S, Aldao A. Gender and age differences in emotion regulation strategies and their relationship to depressive symptoms. Personal Individ Differ 2011 Oct;51(6):704-708. [doi: 10.1016/j.paid.2011.06.012]
63. Munsch S, Hilbert A. Übergewicht und Adipositas, vol 59. Göttingen, Germany: Hogrefe Verlag; 2015.
64. Bohus M, Wolf-Arehult M. Interaktives Skillstraining für Borderline-Patienten. Stuttgart, Germany: Schattauer Verlag; 2013.
65. Eismann E, Lammers CH. Therapie-Tools Emotionsregulation: Mit E-Book inside und Arbeitsmaterial. Weinheim, Baden-Wurttemberg, Germany: Beltz; 2017.
66. Puhl RM, Brownell KD. Confronting and coping with weight stigma: an investigation of overweight and obese adults. Obesity (Silver Spring) 2006 Oct;14(10):1802-1815 [FREE Full text] [doi: 10.1038/oby.2006.208] [Medline: 17062811]
67. Puhl RM, Heuer CA. The stigma of obesity: a review and update. Obesity (Silver Spring) 2009 May;17(5):941-964 [FREE Full text] [doi: 10.1038/oby.2008.636] [Medline: 19165161]
68. Couch D, Han GS, Robinson P, Komesaroff P. Men's weight loss stories: How personal confession, responsibility and transformation work as social control. Health (London) 2019 Jan;23(1):76-96. [doi: 10.1177/1363459317724855] [Medline: 28803501]
69. Hinsch R, Pfingsten U. Gruppentraining sozialer Kompetenzen: GSK; Grundlagen, Durchführung, Anwendungsbeispiele. Weinheim, Baden-Wurttemberg, Germany: Beltz; 2015.
70. Bartholdy S, Dalton B, O'Daly OG, Campbell IC, Schmidt U. A systematic review of the relationship between eating, weight and inhibitory control using the stop signal task. Neurosci Biobehav Rev 2016 May;64:35-62. [doi: 10.1016/j.neubiorev.2016.02.010] [Medline: 26900651]
71. Carey JB, Saules KK, Carr MM. A qualitative analysis of men's experiences of binge eating. Appetite 2017 Sep 01;116:184-195. [doi: 10.1016/j.appet.2017.04.030] [Medline: 28465183]
72. Preuss H, Schnicker K, Legenbauer T. ImpulsE zur Verbesserung der Impuls-und Emotionsregulation: Ein kognitiv-verhaltenstherapeutisches Behandlungsprogramm. Göttingen, Germany: Hogrefe Verlag; 2018.
73. Hofmann W, Friese M, Strack F. Impulse and self-control from a dual-systems perspective. Perspect Psychol Sci 2009 Mar;4(2):162-176. [doi: 10.1111/j.1745-6924.2009.01116.x] [Medline: 26158943]
74. Lavagnino L, Arnone D, Cao B, Soares JC, Selvaraj S. Inhibitory control in obesity and binge eating disorder: a systematic review and meta-analysis of neurocognitive and neuroimaging studies. Neurosci Biobehav Rev 2016 Sep;68:714-726. [doi: 10.1016/j.neubiorev.2016.06.041] [Medline: 27381956]
75. Clark MM, Abrams DB, Niaura RS, Eaton CA, Rossi JS. Self-efficacy in weight management. J Consult Clin Psychol 1991;59(5):739-744. [doi: 10.1037/0022-006X.59.5.739]
76. Richman RM, Loughnan GT, Droulers AM, Steinbeck KS, Caterson ID. Self-efficacy in relation to eating behaviour among obese and non-obese women. Int J Obes Relat Metab Disord 2001 Jun;25(6):907-913. [doi: 10.1038/sj.ijo.0801606] [Medline: 11439307]
77. Linde JA, Rothman AJ, Baldwin AS, Jeffery RW. The impact of self-efficacy on behavior change and weight change among overweight participants in a weight loss trial. Health Psychol 2006 May;25(3):282-291. [doi: 10.1037/0278-6133.25.3.282] [Medline: 16719599]
78. Wolfe BM, Kvach E, Eckel RH. Treatment of obesity. Circ Res 2016 May 27;118(11):1844-1855. [doi: 10.1161/circresaha.116.307591]
79. Moss-Morris R, Weinman J, Petrie K, Horne R, Cameron L, Buick D. The revised illness perception questionnaire (IPQ-R). Psychol Health 2002 Jan;17(1):1-16. [doi: 10.1080/08870440290001494]
80. Jakob R, Harperink S, Rudolf AM, Fleisch E, Haug S, Mair JL, et al. Factors influencing adherence to mHealth apps for prevention or management of noncommunicable diseases: systematic review. J Med Internet Res 2022 May 25;24(5):e35371 [FREE Full text] [doi: 10.2196/35371] [Medline: 35612886]
81. Zhou L, Bao J, Setiawan IM, Saptono A, Parmanto B. The mHealth app usability questionnaire (MAUQ): development and validation study. JMIR Mhealth Uhealth 2019 Apr 11;7(4):e11500 [FREE Full text] [doi: 10.2196/11500] [Medline: 30973342]
82. Liu Y, Gao X, Zhao J, Zhang L, Chen H. Neurocognitive correlates of food-related response inhibition in overweight/obese adults. Brain Topogr 2020 Jan 28;33(1):101-111. [doi: 10.1007/s10548-019-00730-y] [Medline: 31564028]
83. Duraccio KM, Zaugg K, Jensen CD. Effects of sleep restriction on food-related inhibitory control and reward in adolescents. J Pediatr Psychol 2019 Jul 01;44(6):692-702. [doi: 10.1093/jpepsy/jsz008] [Medline: 30861067]
84. Bruch H. Psychological aspects of overeating and obesity. Psychosomatics 1964 Sep 29;5(5):269-274. [doi: 10.1016/S0033-3182(64)72385-7]

85. Konttinen H, Männistö S, Sarlio-Lähteenkorva S, Silventoinen K, Haukkala A. Emotional eating, depressive symptoms and self-reported food consumption. A population-based study. Appetite 2010 Jun;54(3):473-479. [doi: 10.1016/j.appet.2010.01.014] [Medline: 20138944]
86. Henning C, Schroeder S, Steins-Loeber S, Wolstein J. Gender and emotional representation matter: own illness beliefs and their relationship to obesity. Front Nutr 2022;9:799831 [FREE Full text] [doi: 10.3389/fnut.2022.799831] [Medline: 35211498]
87. Smith JM, Serier KN, Belon KE, Sebastian RM, Smith JE. Evaluation of the relationships between dietary restraint, emotional eating, and intuitive eating moderated by sex. Appetite 2020 Dec 01;155:104817. [doi: 10.1016/j.appet.2020.104817] [Medline: 32739329]
88. Davis C, Curtis C, Levitan RD, Carter JC, Kaplan AS, Kennedy JL. Evidence that 'food addiction' is a valid phenotype of obesity. Appetite 2011 Dec;57(3):711-717. [doi: 10.1016/j.appet.2011.08.017] [Medline: 21907742]
89. Meule A. Back by popular demand: a narrative review on the history of food addiction research. Yale J Biol Med 2015 Sep;88(3):295-302 [FREE Full text] [Medline: 26339213]
90. Pape M, Herpertz S, Schroeder S, Seiferth C, Färber T, Wolstein J, et al. Food addiction and its relationship to weight- and addiction-related psychological parameters in individuals with overweight and obesity. Front Psychol 2021;12:736454 [FREE Full text] [doi: 10.3389/fpsyg.2021.736454] [Medline: 34621227]
91. Pursey KM, Stanwell P, Gearhardt AN, Collins CE, Burrows TL. The prevalence of food addiction as assessed by the Yale Food Addiction Scale: a systematic review. Nutrients 2014 Oct 21;6(10):4552-4590 [FREE Full text] [doi: 10.3390/nu6104552] [Medline: 25338274]
92. Burmeister JM, Hinman N, Koball A, Hoffmann DA, Carels RA. Food addiction in adults seeking weight loss treatment. Implications for psychosocial health and weight loss. Appetite 2013 Jan;60(1):103-110. [doi: 10.1016/j.appet.2012.09.013] [Medline: 23017467]
93. Clark SM, Saules KK. Validation of the Yale Food Addiction Scale among a weight-loss surgery population. Eat Behav 2013 Apr;14(2):216-219. [doi: 10.1016/j.eatbeh.2013.01.002] [Medline: 23557824]
94. Meule A, Hermann T, Kübler A. Food addiction in overweight and obese adolescents seeking weight-loss treatment. Eur Eat Disord Rev 2015 May;23(3):193-198. [doi: 10.1002/erv.2355] [Medline: 25778000]
95. Fielding-Singh P, Patel ML, King AC, Gardner CD. Baseline psychosocial and demographic factors associated with study attrition and 12-month weight gain in the DIETFITS trial. Obesity (Silver Spring) 2019 Dec;27(12):1997-2004 [FREE Full text] [doi: 10.1002/oby.22650] [Medline: 31633313]
96. Sikorski C, Spahlholz J, Hartlev M, Riedel-Heller SG. Weight-based discrimination: an ubiquitary phenomenon? Int J Obes (Lond) 2016 Feb;40(2):333-337. [doi: 10.1038/ijo.2015.165] [Medline: 26311336]
97. Lippi D, Bianucci R, Donell S. Gender medicine: its historical roots. Postgrad Med J 2020 Aug;96(1138):480-486. [doi: 10.1136/postgradmedj-2019-137452] [Medline: 32471879]
98. Jake-Schoffman DE, Silfee VJ, Waring ME, Boudreaux ED, Sadasivam RS, Mullen SP, et al. Methods for evaluating the content, usability, and efficacy of commercial mobile health apps. JMIR Mhealth Uhealth 2017 Dec 18;5(12):e190 [FREE Full text] [doi: 10.2196/mhealth.8758] [Medline: 29254914]
99. Signal V, McLeod M, Stanley J, Stairmand J, Sukumaran N, Thompson DM, et al. A mobile- and web-based health intervention program for diabetes and prediabetes self-management (BetaMe/Melon): process evaluation following a randomized controlled trial. J Med Internet Res 2020 Dec 01;22(12):e19150 [FREE Full text] [doi: 10.2196/19150] [Medline: 33258776]
100. Ruf A, Koch ED, Ebner-Priemer U, Knopf M, Reif A, Matura S. Studying microtemporal, within-person processes of diet, physical activity, and related factors using the APPetite-Mobile-App: feasibility, usability, and validation study. J Med Internet Res 2021 Jul 05;23(7):e25850 [FREE Full text] [doi: 10.2196/25850] [Medline: 34342268]
101. van Beurden SB, Smith JR, Lawrence NS, Abraham C, Greaves CJ. Feasibility randomized controlled trial of ImpulsePal: smartphone app-based weight management intervention to reduce impulsive eating in overweight adults. JMIR Form Res 2019 Apr 30;3(2):e11586 [FREE Full text] [doi: 10.2196/11586] [Medline: 31038464]
102. Butryn ML, Martinelli MK, Crane NT, Godfrey K, Roberts SR, Zhang F, et al. Counselor surveillance of digital self-monitoring data: a pilot randomized controlled trial. Obesity (Silver Spring) 2020 Dec;28(12):2339-2346 [FREE Full text] [doi: 10.1002/oby.23015] [Medline: 33098278]
103. Eysenbach G. The law of attrition. J Med Internet Res 2005 Mar 31;7(1):e11-e24 [FREE Full text] [doi: 10.2196/jmir.7.1.e11] [Medline: 15829473]
104. Bühlmeier J, Frölich S, Ludwig C, Knoll-Pientka N, Schmidt B, Föcker M, et al. Changes in patterns of eating habits and food intake during the first German COVID-19 lockdown: results of a cross-sectional online survey. Eur J Nutr 2022 Sep 03;61(6):3293-3306 [FREE Full text] [doi: 10.1007/s00394-022-02919-7] [Medline: 35759031]
105. Moehring K, Weiland A, Reifenscheid M, Naumann E, Wenz A, Rettig T. Inequality in employment trajectories and their socio-economic consequences during the early phase of the COVID-19 pandemic in Germany. JMIR Hum Factors 2018 Apr 17;5(2):e16 [FREE Full text] [doi: 10.31235/osf.io/m95df]
106. Senecal C, Widmer RJ, Larrabee BR, de Andrade M, Lerman LO, Lerman A, et al. A digital health weight loss program in 250,000 individuals. J Obes 2020 Mar 26;2020(5):1-8 [FREE Full text] [doi: 10.1155/2020/9497164]

107. Andone I, Błaszkiewicz K, Eibes M, Trendafilov B, Montag C, Markowetz A. How age and gender affect smartphone usage. Proc Natl Acad Sci U S A 2003 Sep 30;100(20):11696-11701 [FREE Full text] [doi: 10.1145/2968219.2971451]
108. Yang Y, Koenigstorfer J. Determinants of fitness app usage and moderating impacts of education-, motivation-, and gamification-related app features on physical activity intentions: cross-sectional survey study. J Med Internet Res 2021 Jul 13;23(7):e26063 [FREE Full text] [doi: 10.2196/26063] [Medline: 34255656]
109. Smail-Crevier R, Powers G, Noel C, Wang J. Health-related internet usage and design feature preference for e-mental health programs among men and women. J Med Internet Res 2019 Mar 18;21(3):e11224-e11503 [FREE Full text] [doi: 10.2196/11224] [Medline: 30882361]
110. Escoffery C. Gender similarities and differences for e-health behaviors among U.S. adults. Telemed J E Health 2018 May 18;24(5):335-343. [doi: 10.1089/tmj.2017.0136] [Medline: 28813630]
111. Bol N, Helberger N, Weert J. Differences in mobile health app use: a source of new digital inequalities? The Information Society 2018 Apr 26;34(3):183-193 [FREE Full text] [doi: 10.1080/01972243.2018.1438550]
112. Qan'ir Y, Khalifeh AH, Eid M, Hammad B, Al-Batran M. Mobile health apps use among Jordanian outpatients: a descriptive study. Health Informatics J 2021 May;27(2):14604582211017940-14604582vi, xxiii [FREE Full text] [doi: 10.1177/14604582211017940] [Medline: 34030504]
113. Carroll JK, Moorhead A, Bond R, LeBlanc WG, Petrella RJ, Fiscella K. Who uses mobile phone health apps and does use matter? A secondary data analytics approach. J Med Internet Res 2017 Apr 19;19(4):e125 [FREE Full text] [doi: 10.2196/jmir.5604] [Medline: 28428170]
114. Milne-Ives M, Lam C, De Cock C, Van Velthoven MH, Meinert E. Mobile apps for health behavior change in physical activity, diet, drug and alcohol use, and mental health: systematic review. JMIR Mhealth Uhealth 2020 Mar 18;8(3):e17046-e17511 [FREE Full text] [doi: 10.2196/17046] [Medline: 32186518]
115. Dunn CG, Turner-McGrievy GM, Wilcox S, Hutto B. Dietary self-monitoring through calorie tracking but not through a digital photography app is associated with significant weight loss: the 2SMART pilot study-a 6-month randomized trial. J Acad Nutr Diet 2019 Sep;119(9):1525-1532. [doi: 10.1016/j.jand.2019.03.013] [Medline: 31155474]
116. Kliemann N, Croker H, Johnson F, Beeken RJ. Development of the top tips habit-based weight loss app and preliminary indications of its usage, effectiveness, and acceptability: mixed-methods pilot study. JMIR Mhealth Uhealth 2019 May 10;7(5):e12326 [FREE Full text] [doi: 10.2196/12326] [Medline: 31094352]
117. López D, Torres M, Vélez J, Grullon J, Negrón E, Pérez CM, et al. Development and evaluation of a nutritional smartphone application for making smart and healthy choices in grocery shopping. Healthc Inform Res 2017 Jan;23(1):16-24 [FREE Full text] [doi: 10.4258/hir.2017.23.1.16] [Medline: 28261527]
118. Acharya SD, Elci OU, Sereika SM, Music E, Styn MA, Turk MW, et al. Adherence to a behavioral weight loss treatment program enhances weight loss and improvements in biomarkers. Patient Prefer Adherence 2009 Nov 03;3(3):151-160 [FREE Full text] [doi: 10.2147/ppa.s5802] [Medline: 19936157]
119. Alnasser A, Kyle J, Alkhalifah A, Marais D. Relationship between evidence requirements, user expectations, and actual experiences: usability evaluation of the Twazon Arabic weight loss app. JMIR Hum Factors 2018 Apr 17;5(2):e16-e18 [FREE Full text] [doi: 10.2196/humanfactors.9765] [Medline: 29666042]
120. Ferrara G, Kim J, Lin S, Hua J, Seto E. A focused review of smartphone diet-tracking apps: usability, functionality, coherence with behavior change theory, and comparative validity of nutrient intake and energy estimates. JMIR Mhealth Uhealth 2019 May 17;7(5):e9232 [FREE Full text] [doi: 10.2196/mhealth.9232] [Medline: 31102369]

Abbreviations

EE: emotional eating
FA: food addiction
IPQ-R: revised illness perception questionnaire
mHealth: mobile health
WLP: weight loss program

Edited by A Mavragani; submitted 05.04.22; peer-reviewed by H Meggy, H Ranjani; comments to author 11.07.22; revised version received 11.08.22; accepted 29.08.22; published 27.10.22

Please cite as:
Pape M, Färber T, Seiferth C, Roth T, Schroeder S, Wolstein J, Herpertz S, Steins-Loeber S
A Tailored Gender-Sensitive mHealth Weight Loss Intervention (I-GENDO): Development and Process Evaluation
JMIR Form Res 2022;6(10):e38480
URL: https://formative.jmir.org/2022/10/e38480
doi: 10.2196/38480
PMID: