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Menopause and weight loss (ME-WEL) randomised controlled trial: an e-health cognitive-behavioural group intervention for weight management in postmenopausal women

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ABSTRACT

Background: Successful weight management is important for menopausal women, given the high prevalence of overweight and obesity. This study evaluated the efficacy of a cognitive-behavioural e-Health group intervention for weight management in postmenopausal women with overweight or obesity. The intervention incorporates the Health Action Process Approach, Health Belief Model, Oxford Food and Activity Behaviours, and Behaviour Change Techniques.

Methods: This randomised controlled trial involved 27 participants – 13 in the intervention group (IG), who received an 8-week intervention, and 14 in the control group (CG), who received an informative leaflet. Five longitudinal assessments were performed. All variables were measured using quantitative instruments, and Body Mass Index was calculated from self-reported weight and height. Latent growth models (LGM) were conducted according to the intention-to-treat principle.

Results: The LGM showed that some weight management strategies increase significantly over time in IG (energy compensation, regulation: rule setting) and regarding subjective well-being (positive affect and satisfaction with life). Additionally, the IG showed a decrease in emotional and uncontrolled eating, and an increase in self-esteem and health-related determinants.

Discussion: Long-term effects of this cognitive-behavioural intervention were found in some measures, while others only increased for a certain period. Increasing session frequency and incorporating monthly maintenance sessions are recommended to achieve more sustainable results over time.

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1. Introduction

Menopause encompasses a spectrum of symptoms, from physical (e.g. weight gain) to psychological (e.g. mood), with long-term health implications (e.g. cardiometabolic issues; Thurston et al., 2018). Treatment approaches, including hormone therapy and non-hormonal interventions, can alleviate symptoms but may not directly impact weight changes; and caution is warranted with hormone therapy in women with obesity due to associated health risks (Opoku et al., 2023). Contributing factors for weight gain during menopause include biological/physiological, behavioural (e.g. unhealthy eating behaviours, physical inactivity, lack of self-care), environmental (e.g. COVID-19 pandemic), and psycho-social factors (e.g. stressful life events), increases the risk of diseases (e.g. cardiovascular diseases, diabetes, cancers) and mortality (Leitão et al., 2024a; Opoku et al., 2023; Thurston et al., 2018).

Lifestyle changes among menopausal women, including regular physical activity, balanced diet, and maintaining a normal body mass index (BMI), improve health/psychological outcomes (e.g. cardiovascular risk factors, diabetes prevention/management, enhanced quality of life, self-esteem, and subjective well-being; Dugmore et al., 2020; Leitão et al., 2024b). Also, cognitive-behavioural strategies (e.g. planning content, regulation) are underutilized potentially due to perceived barriers and/or lack of information (Leitão et al., 2023a, 2024b; Ranjan et al., 2022). Consequently, interventions focusing on behavioural change in menopausal women are particularly important for preventing chronic diseases, managing menopausal symptoms, and improving weight and body composition (Kracht et al., 2022; Sharifi et al., 2017; Thomson et al., 2020; Thurston et al., 2018). However, the authors argue that more research is needed to assess the effectiveness of these interventions, as studies are still scarce and the interest among menopausal women remains high.

Electronic Health (eHealth) interventions offer cost-effectiveness, reduced waiting lists, and accessibility regardless of location (European Commission, 2021; Tate et al., 2009). These interventions can be delivered individually or collectively, with group-based approaches demonstrating effectiveness in promoting physical activity, eating behaviour, and weight loss (Milne-Ives et al., 2021; Street & Avenell, 2022). Menopausal women may benefit from sharing information and experiences, and combining group formats with online delivery enhances accessibility and effectiveness, improving symptoms and psychological well-being (Kracht et al., 2022; Milne-Ives et al., 2021). Interventions should be grounded in a behaviour change model, with specified active components to facilitate replication in future studies (Michie et al., 2013). The Behaviour Change Technique (BCT) v1 taxonomy, comprising 93 'active ingredients' (i.e. 93 behavioral change techniques), addresses this and is adapted to Portuguese (Félix et al., 2023; Michie et al., 2013).

This study aims to evaluate the efficacy of a cognitive-behavioural e-Health group intervention for weight management in postmenopausal women with overweight or obesity. Drawing on previous research (e.g. Leitão et al., 2023a, 2023b, 2024a, 2024b; 2024c), this intervention incorporates behavioural change models, specifically the Health Action Process Approach (HAPA; Schwarzer, 2008) and the Health Belief Model (HBM; Janz et al., 2002), and cognitive-behavioural taxonomies, specifically BCTs (Michie et al., 2013) and the Oxfoord Food and Activity Behaviours (OxFAB; Hartmann-Boyce

et al., 2016). Our primary objective is to evaluate the intervention's effectiveness in improving the frequency of weight management strategies, subjective well-being, eating behaviour, physical activity, self-efficacy, and self-esteem, along with health-related beliefs and determinants.

2. Method

2.1. Design

In this randomised controlled trial (RCT), participants underwent several moments of assessment (through self-report questionnaires delivered online): baseline (T0—March 2023), 1-month (T1; midpoint of intervention, April 2023), 2-months (T2; end of intervention, May 2023), and 3- (T3, August 2023) and 6-month follow-ups (T4, November 2023). Also, this RCT is structured as a two-arm (experimental and control condition), and spanned 40 weeks, with an intervention period lasting 8 weeks.

2.2. Ethical approval

This study, as part of the MEnopause and WEight Loss (ME-WEL) project, obtained approval from the Ethics Committee of Ispa—Instituto Universitário (ref. D/024/01/2020). The ME-WEL intervention adhered to the principles of the Declaration of Helsinki followed the deontological norms and ethical principles of the Portuguese Psychologists Association (Order of Portuguese Psychologists, 2011), and complied with the General Data Protection Regulation (Lei da Proteção de Dados Pessoais n. 58/2019, 2019). The ME-WEL intervention protocol was rigistered and approved by ClinicalTrials.gov (NCT0593157). Furthermore, this study was conducted according to the CONSORT guidelines (Schulz et al., 2010).

2.3. Participants and procedure

2.3.1. Participants recruitment

During the initial recruitment phase of the ME-WEL project, an online sample of middle-aged women was collected. Interested participants in the intervention phase provided contact details and received an email outlining the intervention's objectives with a link to a screening questionnaire. The invitation was also shared on Facebook (targeting groups of middle-aged women and menopause), from February 22 to March 19, 2023, using a convenience and snowball sampling approach.

Inclusion criteria were: (i) post-menopausal women (last menstrual period at least 12 months ago), (ii) aged 45–65, (iii) Portuguese or dual nationality, (iv) BMI ≥ 25kg/m^2 (indicative of overweight/obesity), and (v) access to a computer with internet. All degrees of obesity were included in the intervention, as it focused on lifestyle changes rather than just weight loss, and recognizing that psychological factors play a crucial role in obesity management and treatment success, especially for individuals with severe obesity (BMI ≥ 40 kg/m^2; Schutz et al., 2019). Exclusion criteria included: (i) specific diseases (stroke, cancer, diabetes, heart disease, epilepsy, severe musculoskeletal issues), (ii) conditions limiting mobility/activity, (iii) psychiatric illness or recent

psychiatric hospitalization, (iv) history of alcohol and/or illicit substances addiction, and (vi) active suicidal ideation.

Before the T0 assessment, women received informed consent detailing intervention aims, the randomisation process (Intervention group [IG] and Control group [CG]), voucher drawing, and other relevant details. Furthermore, it was communicated that CG members would receive the intervention after all evaluation stages, starting December 2023. The CG was randomly selected from a community sample rather than from a specific group (e.g. slimming club) - like the IG - because the primary objective was not to include women who were already actively engaged in weight management strategies or who had adopted healthy lifestyle habits. Instead, the goal was for participants to share their barriers, challenges, everyday strategies (whether related to physical activity), and cues to action for change. Selecting a sample from a slimming club, for example, could have resulted in the loss of valuable information relevant to the intervention's aims, such as the need to increase cues to action or promote physical activity.

2.3.2. Randomisation process

Participants were randomly assigned to the CG or IG. Within the IG, women were further randomised into Group 1 and Group 2 to ensure small group dynamics and accommodate session time constraints (Dutton et al., 2014). An independent researcher used random.org for randomisation. Participants received alphanumeric codes to maintain data anonymity across assessments. Thus, the participant allocation process was blinded, and the principal researcher had no access to it.

Compensation in gift cards was raffled at T2 (€50 for CG and €50 for IG) and T4 (€50 for CG and €50 for IG) by an independent researcher, as done in other RCTs (Rosas et al., 2022). Eligibility for vouchers at T2 required completing T0, T1, and T2 assessments, and at T4 required completing all intervention moments (T0, T1, T2, T3, and T4).

The IG comprised 17 women (8 in Group 1 and 9 in Group 2), while CG had 18 participants. Dropouts occurred in both groups, with 27 women completing all assessments (13 in IG and 14 in CG). Recruitment data is detailed in Figure 1.

2.3.3. Intervention group

In the ME-WEL intervention, women engaged in 8-week online sessions *via* Zoom, each lasting 90 min. The sessions were entirely developed by the research team, one by one, based on three key elements: (i) difficulties identified in previous studies on menopausal women (e.g. Leitão et al., 2023a, 2024b; 2024c) - e.g. studies reporting that postmenopausal women with overweight/obesity face multiple barriers to weight management; thus, one of the intervention sessions focused specifically on perceived barriers; (ii) behavioural change models (HAPA and HBM) - all dimensions of these models were integrated and addressed throughout the sessions; and (iii) behaviour change taxonomies (BCT and OxFAB) - strategies for behaviour change and weight management were incorporated based on these taxonomies and the main findings from the aforementioned studies - e.g. women who successfully maintained a healthy weight during menopause reported using planning

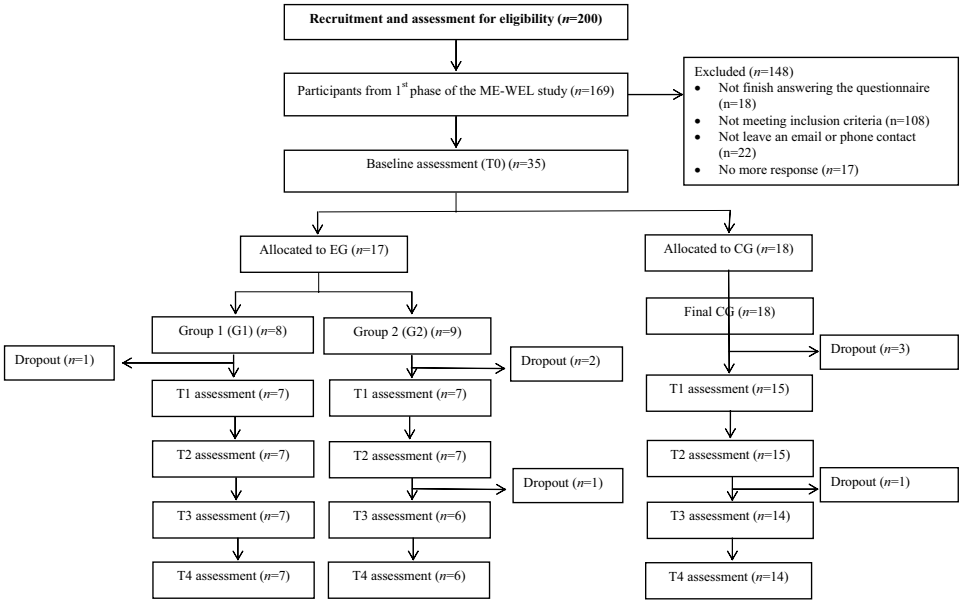

Figure 1. Flowchart of the ME-WEL intervention participants.

as a key strategy, which was therefore included as a technique in the intervention sessions.

The first session had a particular structure, including sharing objectives and intervention procedures, and members' introductions. Subsequent sessions followed a structured outline: (1) *Homework sharing* (participants used "Logbooks" to record and share completed homework); (2) *Weekly Challenge sharing* (each session introduced a challenge (e.g. walking) designed to encourage tailored behavioural changes. Women discussed successes and setbacks, receiving positive reinforcement or strategies to overcome barriers); (3) *Session Theme sharing* (the session's theme was introduced); (4) *Psychoeducation* (women received education on the session topic); (5) *Group exercises* (activities encouraged group participation and sharing); (6) *Homework and Weekly Challenge sharing* (women received the homework and weekly challenge for the upcoming week). PowerPoint presentations and session links were shared *via* email and *WhatsApp*. *WhatsApp* groups for Group 1 and Group 2 were created, with women's consent, to facilitate sharing information, experiences, doubts, and achievements. The researcher responsible for the intervention was included in both *WhatsApp* groups. Table 1 provides session details and associated behavioural change determinants and techniques.

2.3.4. Control group

In the CG, participants received an informative leaflet on Awareness for the Rational Use of Antibiotics (from the European Centre for Disease Prevention and Control), *via* email when the IG started their first session. The only contact with the CG was during the mid-intervention assessment (T1) when both groups received a questionnaire link *via* email and short message service (SMS). This procedure is repeated at each assessment. Women in both groups remained about voucher allocation upon completing

Table 1. A brief description of the ME-WEL intervention, implemented with the intervention group.

Intervention week and Thematic theme	Goals	Targeted cognitions/behaviours	Intervention components and techniques derived from behaviour change taxonomies (BCT and OxFAB)
Intervention week 1			
Why start managing my weight?	Introduction and clarification of ME-WEL Intervention objectives. Sharing scientific knowledge concerning menopause, weight gain, obesity, and eating behaviour. Clarification of the health psychologist's role in weight management and providing credible information on healthy eating and physical exercise recommendations sourced from the World Health Organization. Exercise – "Where do I see myself in three months, if I change my behaviour?" Establishing a contract among the group, to outline clear expectations and responsibilities. Creating a WhatsApp group, to facilitate communication and support. **Homework** *Logbook:* Women were prompted to reflect and answer the question "What is my excess weight making me lose?" *Weekly Challenge*: Participants were encouraged to commit to walking at least once a week.	**HAPA** (Outcome expectancies) **Weight management strategies** (driven by OxFAB) **Eating behaviour** (Emotional eating, uncontrolled eating, cognitive restraint) **Physical activity**	**BCTs (**1.1. Goal setting [behaviour]; 1.8. Behavioural contract; 3.2. Social support [practical]; 8.7. Graded tasks; 9.1. Credible source; 9.3. Comparative imagining of future outcomes) **OxFAB** (Information seeking; Self-monitoring; Support: help from others)
Intervention week 2			
And if I do not manage my weight, what could happen?	Review of Logbook and the Weekly Challenge. Providing information on the risk factors associated with a sedentary lifestyle and unhealthy eating behaviours, including their emotional consequences. (Understanding the links between their actions and the subsequent outcomes). Addressing participants' feelings of vulnerability to diseases associated with obesity, and their intentions to adopt healthy behaviours. Sharing some cognitive-behavioural strategies. **Homework** *Logbook:* Women were required to answer the question "What behavioural changes do I want to make to manage my weight?" *Weekly Challenge:* Participants were tasked with including three portions of vegetables at mealtimes for, at least, two days. Additionally, they were encouraged to continue maintaining the weekly challenge from week 1.	**HAPA** (Risk perception, intention) **HBM** (Perceived susceptibility, perceived severity) **Weight management strategies** (driven by OxFAB) **Eating behaviour** (Emotional eating, uncontrolled eating, cognitive restraint) **Physical activity**	**BCTs (**1.1. Goal setting [behaviour]; 5.1. Information about health consequences; 5.3 Information about social and environmental consequences; 5.6 Information about emotional consequences; 8.7. Graded tasks) **OxFAB** (Energy compensation; Impulse management: distraction; Planning content; Self-monitoring; Scheduling of diet and activity)

(*Continued*)

Table 1. Continued.

Intervention week and Thematic theme	Goals	Targeted cognitions/behaviours	Intervention components and techniques derived from behaviour change taxonomies (BCT and OxFAB)
Intervention week 3			
Why do I want to do it? How will I do it?	Review of Logbook and the Weekly Challenge. Choose one of the identified behaviours and write it on a Post-it note, which should then be stuck on the mirror/fridge, etc. Building and establishing the confidence to start weight management, formulating intentions for weight loss, and sharing information about cues to action. Exercise about individual (and group) cues that can drive behavioural change. A brief approach to the importance of planning and habit formation - SMART objectives. Sharing information about action self-efficacy. Group exercises on self-efficacy and identification of past successes. **Homework** *Logbook:* Women were asked to write down three characteristics they had that could help them reduce their levels of sedentary lifestyle and unhealthy eating. *Weekly Challenge:* Participants were tasked with refraining from consuming sugar for two days of the week. (Information about reading labels and identifying foods with added sugar was shared). Additionally, they were encouraged to continue maintaining the weekly challenges from weeks 1 and 2.	**HAPA** (Action self-efficacy, action planning, intention) **HBM** (Cues to action) **Weight management strategies** (driven by OxFAB) **Eating behaviour** (Emotional eating, uncontrolled eating, cognitive restraint) **Physical activity**	**BCTs (**1.1. Goal setting [behaviour]; 1.4. Action planning; 4.1. Instruction on how to perform a behavior; 5.1. Information about health consequences; **7**.1. Prompt/cues; 8.7. Graded tasks; 13.2. Framing/ reframing; 13.4. Valued self-identity; 15.1. Verbal persuasion about capabilities 15.3. Focus on past success) **OxFAB** (Goal setting; Planning content; Self-monitoring, Scheduling of diet and activity)
Intervention week 4			
What is most difficult about this process?	Review of Logbook and the Weekly Challenge. Sharing information about the barriers associated with weight management identified in previous studies (e.g. Leitão et al., 2024b). Group exercise to identify individual barriers to weight management and brainstorm possible solutions to initiate the behaviours. Sharing some cognitive-behavioural strategies for overcoming these barriers, according to OxFAB-MAW. **Homework** *Logbook:* Women were asked to fill out an action planning table regarding the implementation of a behaviour. *Weekly Challenge:* Women were required to drink 2 liters of water (at least two days of the week) or 1.5 liters of water (at least 3 days of the week). Additionally, they were encouraged to continue maintaining the weekly challenges from weeks 1, 2, and 3.	**HBM** (Perceived barriers) **Weight management strategies** (driven by OxFAB) **Eating behaviour** (Emotional eating, uncontrolled eating, cognitive restraint) **Physical activity**	**BCTs (**1.1. Goal setting [behaviour]; 1.2. Problem-solving; 1.4. Action planning; 8.7. Graded tasks) **OxFAB** (Energy compensation; Goal setting; Imitation: modelling; Impulse management: acceptance; Impulse management: awareness of motives; Impulse management: distraction; Information seeking; Planning content; Regulation: allowances; Regulation: rule setting; Regulation: restrictions; Restraint; Scheduling of diet and activity; Self-monitoring; Stimulus control; Support: help from others; Support: motivational)

(*Continued*)

Table 1. Continued.

Intervention week and Thematic theme	Goals	Targeted cognitions/behaviours	Intervention components and techniques derived from behaviour change taxonomies (BCT and OxFAB)
Intervention week 5			
My mirror, my mirror, is there anyone more beautiful than me?	Review of Logbook and the Weekly Challenge. Sharing information about the concept of self-esteem. Group exercises aimed at enabling patients to become more self-accepting, revising negative self-beliefs, and establishing more positive beliefs about the "new" Self. Also, the group and the therapist identified positive characteristics in each woman. **Homework** *Logbook:* Women were encouraged to ask significant others (e.g. family, friends, colleagues) what they value and appreciate about them. *Weekly Challenge:* Women were required to engage in at least one self-care behaviour during the week (e.g. visit a hairdresser, get a massage). Additionally, they were encouraged to continue maintaining the weekly challenges from weeks 1, 2, 3, and 4.	**Self-esteem** **Weight management strategies** (driven by OxFAB)	**BCTs (**1.1. Goal setting [behaviour]; 3.3. Social support [emotional]; 8.7. Graded tasks; 13.4. Valued self-identity; 13.5. Identity associated with changed behaviour; 15.1. Verbal persuasion about capabilities) **OxFAb** (Goal setting; Planning content; Scheduling of diet and activity; Self-monitoring)
Intervention week 6			
Behavioural changes: Are there associated benefits or not?	Review of Logbook and the Weekly Challenge. Sharing information about the action planning concept, emphasizing the importance of planning when, where, how, and with whom to conduct physical exercise and healthy eating. Providing information on the benefits of healthy weight management and a healthy lifestyle. Group exercise to discuss the benefits gained from adopting the new healthy behaviours. Dysfunctional eating behaviours, emotion literacy and regulation, and associated strategies (weight management strategies and relaxation). **Homework** *Logbook:* Women were encouraged to monitor the benefits they identified as resulting from specific health behaviours they engaged in during the week. *Weekly Challenge:* Women were encouraged to commit to walking at least three times a week. Additionally, they were encouraged to continue maintaining the weekly challenges from weeks 2, 3, 4, and 5.	**HAPA** (Action planning) **HBM** (Perceived benefits) **Weight management strategies** (driven by OxFAB) **Eating behaviour** (Emotional eating, uncontrolled eating, cognitive restraint) **Physical activity**	**BCTs (**1.1. Goal setting [behaviour]; 1.4. Action Planning; 1.6. Discrepancy between current behaviour and goal; 2.4. Self-monitoring of outcome(s) of behaviour; 8.7. Graded tasks; 11.2. Reduce the negative emotions) **OxFAB** (Energy compensation; Goal setting; Impulse management: acceptance; Impulse management: awareness of motives; Impulse management: distraction; Planning content; Scheduling of diet and activity; Self-monitoring)

(*Continued*)

Table 1. Continued.

Intervention week and Thematic theme	Goals	Targeted cognitions/behaviours	Intervention components and techniques derived from behaviour change taxonomies (BCT and OxFAB)
Intervention week 7 *And if something happens that does not allow me to continue with these behaviours?*	Review of Logbook and the Weekly Challenge. Sharing information about the coping planning concept. Group exercise to identify individual barriers and possibly unforeseen events and develop strategies to cope with these unforeseen events/barriers that may interfere with weight management. Sharing information about the maintenance self-efficacy concept. Group exercise to develop confidence in maintaining regular physical activity and healthy eating, even in the face of unforeseen events/barriers. **Homework** *Logbook:* Women were encouraged to think and write about what could happen to make them give up on their healthy behaviours (unforeseen events/barriers). Additionally, they were asked to think and write about what could prevent that from happening (coping planning). *Weekly Challenge:* Women were encouraged to replace an unhealthy behaviour with a healthy one. Additionally, they were encouraged to continue maintaining the weekly challenges from weeks 2, 3, 4, 5, and 6.	**HAPA** (Coping planning, maintenance self-efficacy) **HBM** (Perceived barriers) **Weight management strategies** (driven by OxFAB) **Eating behaviour** (Emotional eating, uncontrolled eating, cognitive restraint) **Physical activity**	**BCTs (**1.1. Goal setting [behaviour]; 1.2. Problem-solving; 2.4. Self-monitoring of outcome(s) of behaviour; 8.2. Behaviour substitution; 8.7. Graded tasks; 15.1. Verbal persuasion about capabilities; 15.3. Focus on past success) **OxFAB** (Goal setting; Planning content; Regulation: restrictions; Restraint; Scheduling of diet and activity; Self-monitoring)
Intervention week 8 *How will I maintain these achievements*?	Review of Logbook and the Weekly Challenge. Sharing information about the recovery self-efficacy concept. Developing confidence in maintaining healthy behaviours even if they are interrupted for a certain period. Group exercise - "Who is this new me and how will he behave?". Sharing information about the action control concept. Sharing strategies to remind and monitor weight management efforts.	**HAPA** (Recovery self-efficacy, action control) **Weight management strategies** (driven by OxFAB)	**BCTs** (2.3. Self-monitoring of behaviour; 13.5. Identity associated with changed behaviour; 15.2. Mental rehearsal of successful performance; 15.4. Self-talk) **OxFAB** (Energy compensation; Goal setting; Imitation: modelling; Impulse management: acceptance; Impulse management: awareness of motives; Impulse management: distraction; Information seeking; Planning content; Regulation: allowances; Regulation: rule setting; Regulation: restrictions; Restraint; Scheduling of diet and activity; Self-monitoring; Stimulus control; Support: help from others; Support: motivational)

assessments. The CG was informed that after all assessments, they would receive the IG's intervention free of charge and without obligation regarding participation, starting January 2024. The CG did not have access to *WhatsApp* groups.

2.4. Measures

A self-reported protocol was developed, comprising sociodemographic, health-related, lifestyle, psychological (HAPA and HBM-related variables, self-esteem, subjective well-being), and behavioural (weight management strategies, eating behaviour, and physical activity) aspects.

2.4.1. Primary outcomes measures

2.4.1.1. Weight management strategies. Cognitive-behavioural weight management strategies were evaluated using the Oxford Food and Activity Behaviours in Middle-Aged Women (OxFAB-MAW; Leitão et al., 2023a). The OxFAB-MAW assessed 47 items across 17 dimensions: *energy compensation, goal setting, imitation: modeling, impulse management: acceptance, impulse management: awareness of motives, impulse management: distraction, information seeking, planning content, regulation: allowances; regulation: rule setting; regulation: restrictions, restraint, scheduling of diet and activity, self-monitoring, stimulus control, support: help from others,* and *support: motivational*. Responses ranged from 0 (never) to 4 (always), with higher scores indicating more frequent strategy use. The OxFAB-MAW demonstrated good psychometric properties (Leitão et al., 2023a).

2.4.1.2. Subjective well-being. Subjective well-being includes affective and cognitive facets. The affective facet was evaluated using the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), with separate scales for *positive* and *negative affect*, rated on a 1 (very slightly or not at all) to 5 (extremely) scale. This study employed a 10-item short version of PANAS, which demonstrated good psychometric properties (Galinha et al., 2014). A higher mean score indicated a greater *positive/negative affect*.

The cognitive facet of subjective well-being was assessed using the Satisfaction with Life Scale (SWLS; Diener et al., 1985), which measured *life satisfaction* with five items rated from 1 (strongly disagree) to 7 (strongly agree). SWLS demonstrated good psychometric properties (Figueiras et al., 2010). A higher mean score indicated greater *life satisfaction*.

2.4.2. Secondary outcomes measures

2.4.2.1. Weight. Women self-reported their current weight, a method utilized in previous weight management studies (Saghafi-Asl et al., 2020).

2.4.2.2. Eating behaviour. Eating behaviour was assessed using the Three Factor Eating Questionnaire (TFEQ-R21; Stunkard & Messick, 1985). TFEQ-R21 comprised 21 items across three dimensions: *cognitive restriction, emotional eating,* and

uncontrolled eating. Items 1–20 were rated on a 0 to 4-point Likert scale, while item 21 was answered on an 8-point Likert scale (subsequently transformed to a 4-point range). The TFEQ-R21 showed good psychometric properties (Leitão et al., 2024c), with higher scores indicating more *cognitive restriction, emotional eating,* or *uncontrolled eating*.

2.4.2.3. Physical activity. The International Physical Activity Questionnaire (IPAQ) assessed physical activity and sedentary behaviour levels. This study employed the IPAQ short form, comprising nine items assessing the frequency and duration of *vigorous activity, moderate activity, walking,* and *sedentary behaviour* over the past week (each activity lasting ≥10 min). Weekly minutes for each activity were calculated following IPAQ guidelines (IPAQ group, 2015), through MET level (the oxygen consumption at rest – 3.5 ml O_2/kg/min) × minutes per day × days per week, expressed in MET-min/week. According to IPAQ guidelines (IPAQ group, 2015**)**, MET values used are: Walking MET-minutes/week = 3.3 * walking minutes * walking days; Moderate activities MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days; Vigorous activities MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days; Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous MET minutes/week scores. Sedentary behaviour is not included in this score. The IPAQ, validated in 12 countries, demonstrated acceptable psychometric properties (Craig et al., 2003).

2.4.2.4. Health beliefs. To assess the HBM constructs, our team developed a 40-item instrument based on Saghafi-Asl et al. (2020). It covers *perceived severity, perceived barriers, perceived benefits,* and *cues to action*, rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This instrument underwent validation with 227 women with a BMI ≥ 25kg/m^2. A confirmatory factor analysis was conducted, and all dimensions showed acceptable to good model fit, internal consistency (0.68 ≤ Cronbach's alpha ≤ 0.92 and 0.62≤ McDonald's' Omega ≤ 0.88), and convergent validity (0.41≤ Average Variance Extracted ≤0.71).

Perceived susceptibility and *self-efficacy* dimensions were adapted from the HAPA instrument, tailored to weight management, and validated in middle-aged women (Leitão et al., 2023b). These dimensions consist of 3 and 14 items respectively, rated on a Likert scale ranging from 1 (e.g. strongly disagree) to 5 (strongly agree). These items exhibited good psychometric properties (Leitão et al., 2023b), with higher scores indicating a greater presence of the construct.

2.4.2.5. Behavioural change determinants. Behaviour change determinants were assessed using a HAPA-based instrument adapted for weight management in middle-aged women (Leitão et al., 2023b). This instrument included 42 items representing *risk perception, outcome expectancies, action self-efficacy, intention, maintenance self-efficacy, recovery self-efficacy, action planning, coping planning,* and *action control*. Responses ranged from 1 (e.g. extremely unlikely/completely disagree) to 5 (e.g. extremely likely/completely agree). Validity and reliability were

demonstrated (Leitão et al., 2023b), with higher scores indicating a stronger manifestation of each construct.

2.4.2.6. Self-esteem. Self-esteem was assessed using the Rosenberg Self-Esteem Scale-RSES (Rosenberg, 1965). This one-dimensional instrument evaluated global attitudes toward the self with ten items, categorized into positive and negative attitudes. Responses ranged from 0 (strongly disagree) to 3 (strongly agree), where higher scores indicated higher levels of self-esteem. Scores below 15 (poor self-esteem) suggested potential self-esteem issues, 15–25 average self-esteem, and 26–30 high self-esteem. The instrument has demonstrated good psychometric properties (Neto, 1996).

2.4.3. Data analyses

Before data collection, a power calculation using G*Power software (version 3.1.9.4.) determined a minimum sample size of 34 participants, considering a repeated-measures design, effect size of 0.50, power of 95%, and significance level of 0.05, with non-sphericity correction ($\varepsilon = 1$; Kang, 2021). Anticipating a 25–30% dropout rate in longitudinal studies (Hernández-Reyes et al., 2020), recruitment targeted at least 43 participants. Descriptive statistics (Means [*M*] and Standard deviations [*SD*]) and item sensitivity analysis (Skewness [*Sk*] and Kurtosis [*Ku*]) were conducted, showing no severe deviations from a normal distribution $Sk \geq 3$ and $Ku \geq 10$ values (Marôco, 2021). Latent Growth Models (LGM) assessed intervention effectiveness from T0 to T4 for both groups, following the intention-to-treat principle. LGM offers a more comprehensive approach by accounting for individual change variability (Marôco, 2021; Wickrama et al., 2016). Separate models were specified to prevent power loss due to many parameters.

Intraindividual LGM was initially fitted, comprising a latent intercept (baseline) and a slope factor (rate of change) for each measure (Wickrama et al., 2016). Subsequently, interindividual conditional LGM was performed, exploring group effects on individual variations in behavioural change (slopes). This involved analyzing group effects at baseline (intercept) and change rate (slope), conducting group as a covariate coded 0 (CG) and 1 (IG). The maximum growth (1) was fixed on the time where the mean value of the variable was higher. All others were kept free. Parameters were estimated using model fit thresholds: Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) >0.90, Root Mean Square Error of Approximation (RMSEA), with a 90% confidence interval, and Standardised Root Mean Square Residual (SRMR) values <0.08, and the chi-square statistics ($\chi^2[df]$) <5 (Marôco, 2021). RMSEA and SRMR values tend to be overestimated for models with few degrees of freedom (Marôco, 2021). Due to the very reduced degrees of freedom, some models were found to be close to saturation; in such cases, goodness of fit indices were rounded down to 1 (Marôco, 2021).

The full maximum likelihood approach in the Lavaan R package (a robust method for handling missing data) and imputation of missing values were employed (Enders & Bandalos, 2001; Marôco, 2021), with a 24% dropout rate from T0 to T4. Little's Missing Completely At Random test confirmed data missing at random (χ^2=145.15, $df = 1126.00$, $p = 1.00$), ensuring the final sample's representativeness of the

hypothetically complete data (Little & Rubin, 2002). Dropout rate differences between groups were analysed using cross-tabulation and a chi-square test. To assess different magnitudes (effect size) of significant measures, standardized regression coefficients (β) were reported. Cohen's *d* values are commonly reported to evaluate effect sizes: small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$). For β, the values should be interpreted as small (0.10–0.29), medium (0.30–0.49), and large (≥0.50; Cohen, 1988).

Analyses were conducted using IBM SPSS Statistics software (v. 28), and R (v.4.2.3; R Core Team, 2020), through RStudio (v.2023.06.1 + 524; RStudio Team, 2020) with the R-Lavaan package (v.0.6.15; Rosseel, 2012) and semTools package (v.0.5-6; Jorgensen et al., 2022). A significance level of 0.05 was applied; however, marginally significant results up to 0.09 were considered, following Fisher's (1992) recommendations.

3. Results

3.1. Participant flow and characteristics, and item distribution

Recruitment data, intervention allocation, follow-up, and dropout details are described in Figure 1. Table 2 presents the sociodemographic, health, and lifestyle characteristics of IG, CG, and the total sample. Concerning current weight loss attempts, at T0, 88.2% of women in the IG were making current weight loss attempts, compared to 76.9% at T4. In the CG, at baseline 55.6% were making current weight loss attempts, and at T4, increased to 57.1%. Table 3 shows mean, standard deviation, and minimum and maximum values for *Sk* and *Ku* of items assessed over time, meeting LGM normality assumptions. Dropouts did not differ between IG and CG (χ^2=0.237, $p = 0.627$).

3.2. Intervention effects (intraindividual) on primary and secondary outcomes

LGMs assessed changes in primary (weight management strategies and subjective well-being) and secondary outcomes (weight, eating behaviour, physical activity, health beliefs, behaviour change determinants, and self-esteem) within individuals (intraindividual) over time in both IG and CG. LGMs analysis revealed sufferable to good fit concerning the structure of variance, covariance, and means in the IG ($0.842 \leq CFI \leq 1.000$; $0.775 \leq TLI \leq 1.000$; $0.000 \leq RMSEA \leq 0.339$; $0.046 \leq SRMR \leq 0.493$; $X^2(7)$=0.449, $p = 1.000$ to $X^2(11)$=14.340, $p = 0.215$). We acknowledge the potential overestimation of RMSEA and SRMR in models with few degrees of freedom (Marôco, 2021). In the CG, a sufferable to good fit was also observed ($0.858 \leq CFI \leq 1.000$; $0.828 \leq TLI \leq 1.000$; $0.000 \leq RMSEA \leq 0.438$; $0.046 \leq SRMR \leq 0.329$; $X^2(7)$=0.808, $p = 0.997$ to $X^2(11)$=34.549, $p < 0.001$; Table 4).

3.2.1. Intervention group

Table 4 presented significant changes in several variables among the IG across different assessment moments. The parameter estimates showed non-significant variances (V(Intercept)=0.010 to 21.707, SE = 0.042 to 16.713, $p = 0.140$ to 0.994), suggesting no variability in the baseline values for *impulse management: distraction, regulation: allowances, regulation: restrictions, satisfaction with life, positive affect, uncontrolled eating,*

Table 2. Participants sociodemographic, health, and lifestyle characteristics.

	Intervention group ($n = 17$)		Control group ($n = 18$)		Total ($n = 35$)	
	n	%	*n*	%	*n*	%
Age (M ± SD)	56.33 ± 5.04 years		55.33 ± 3.80 years		55.79 ± 4.36 years	
Nationality						
Portuguese	14	82.4	16	88.9	30	85.7
Dual nationality	3	17.6	2	11.1	5	14.3
Relationship status						
In a relationship, cohabiting	9	52.9	12	66.7	21	60
In a relationship, not cohabiting	4	23.5	2	11.1	6	17.1
Single	4	23.5	4	22.2	8	22.9
Parity						
Yes	15	88.2	16	88.9	31	88.6
No	2	11.8	2	11.1	4	11.4
Highest education level obtained						
Middle school	–	–	1	5.6	1	2.9
High school	4	23.5	7	38.9	11	31.5
Bachelor	9	52.9	7	38.9	16	45.7
Master	4	23.5	2	11.1	6	17.1
Doctorate	–	–	1	5.6	1	2.9
Professional status						
Active	16	94.1	17	94.4	33	94.3
Inactive (e.g. retired)	1	5.9	1	5.6	2	5.7
Annual household income						
< 10.000€	2	11.8	3	16.7	5	14.3
10.001€–20.000€	2	11.8	5	27.8	7	20
20.001€–37.500€	10	58.8	6	33.3	16	45.7
37.501€–70.000€	3	17.6	4	22.2	7	20
Recent disease						
Yes	3	17.6	4	22.2	7	20
No	14	82.4	14	77.8	28	80
Body Mass Index (BMI)						
Overweight (25.0 kg/m^2< BMI ≤ 29.9 kg/m^2)	10	58.7	12	66.4	22	62.4
Obesity I (30.0 kg/m^2≤ BMI ≤ 34.9 kg/m^2)	5	29.5	2	11.2	7	20.2
Obesity II (35.0 kg/m^2≤ BMI ≤ 39.9 kg/m^2)	1	5.9	3	16.8	4	11.6
Obesity III (BMI ≤ 40.0 kg/m^2)	1	5.9	1	5.6	2	5.8
Duration of current weight						
Less than a year	4	23.5	5	27.8	9	25.7
One year	4	23.5	3	16.7	7	20
Between two and four years	5	29.5	7	38.9	12	34.3
Between five and ten years	4	23.5	3	16.7	7	20
Obesity in the past						
Yes	5	29.4	4	22.2	9	25.7
No	12	70.6	14	77.8	26	74.3
Family history of obesity						
Yes	9	52.9	6	33.3	15	42.9
No	8	47.1	12	66.7	20	57.1
Smoking						
Yes	4	23.5	5	27.8	9	25.7
No	13	76.5	13	72.2	26	74.3
Alcohol consumption						
Yes	13	76.5	12	66.7	25	71.4
No	4	23.5	6	33.3	10	28.6
Coffee consumption						
Yes	14	82.4	17	94.4	31	88.6
No	3	17.6	1	5.6	4	11.4

walking, vigorous physical activity, moderate physical activity, perceived severity, perceived benefits, cues to action, and *risk perception*. On the other hand, there was inter-variability in the baseline values (V(Intercept)=0.068 to 196.713, SE = 0.022 to 51.213, $p < 0.001$

Table 3. Descriptive statistics and items sensitivity of ME-WEL intervention variables in both groups (Intervention and Control groups) at all measurement times.

	T0 – Baseline Pre-intervention		T1 Mid-way assessment		T2 Post-intervention		T3 3-month follow-up		T4 6-month follow-up	
Variables	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*
Weight management strategies ($-1.07 \leq Sk \leq 2.03$; $-1.64 \leq Ku \leq 2.95$)										
Energy compensation	35	2.49 ± 0.95	29	2.60 ± 0.84	29	2.90 ± 0.91	27	2.69 ± 1.06	27	2.65 ± 0.84
IG	17	2.44 ± 0.98	14	3.00 ± 0.68	14	3.21 ± 0.91	13	2.73 ± 0.63	13	2.54 ± 0.72
CG	18	2.53 ± 0.95	15	2.23 ± 0.82	15	2.60 ± 0.83	14	2.64 ± 1.36	14	2.75 ± 0.96
Goal setting	35	2.64 ± 0.73	29	2.81 ± 0.69	29	2.92 ± 0.78	27	2.50 ± 0.90	27	2.67 ± 0.77
IG	17	2.75 ± 0.60	14	3.02 ± 0.49	14	3.36 ± 0.55	13	2.44 ± 0.74	13	2.59 ± 0.75
CG	18	2.54 ± 0.84	15	2.62 ± 0.81	15	2.52 ± 0.75	14	2.55 ± 1.04	14	2.73 ± 0.81
Imitation: Modelling	35	2.10 ± 0.76	29	1.98 ± 0.76	29	1.99 ± 0.66	27	1.89 ± 0.77	27	1.90 ± 0.87
IG	17	2.20 ± 0.70	14	2.07 ± 0.73	14	2.10 ± 0.74	13	1.82 ± 0.65	13	1.82 ± 0.81
CG	18	1.83 ± 0.79	15	1.89 ± 0.79	15	1.89 ± 0.59	14	1.95 ± 0.89	14	1.98 ± 0.95
Impulse management: Acceptance	35	2.90 ± 0.75	29	3.14 ± 0.60	29	3.39 ± 0.65	27	3.08 ± 0.80	27	3.05 ± 0.71
IG	17	3.07 ± 0.74	14	3.23 ± 0.50	14	3.70 ± 0.57	13	3.37 ± 0.77	13	3.00 ± 0.65
CG	18	2.74 ± 0.73	15	3.05 ± 0.68	15	3.10 ± 0.60	14	2.82 ± 0.76	14	3.09 ± 0.78
Impulse management: Awareness of motives	35	3.06 ± 0.92	29	3.09 ± 0.77	29	3.21 ± 0.73	27	3.22 ± 0.86	27	2.96 ± 0.81
IG	17	3.09 ± 0.83	14	3.04 ± 0.91	14	3.32 ± 0.80	13	3.35 ± 0.83	13	2.73 ± 0.60
CG	18	3.03 ± 1.02	15	3.13 ± 0.64	15	3.10 ± 0.66	14	3.11 ± 0.90	14	3.11 ± 0.90
Impulse management: Distraction	35	2.50 ± 0.74	29	2.93 ± 0.63	29	3.00 ± 0.61	27	2.78 ± 0.70	27	2.88 ± 0.65
IG	17	2.41 ± 0.81	14	2.86 ± 0.65	14	3.24 ± 0.55	13	2.67 ± 0.59	13	2.51 ± 0.66
CG	18	2.57 ± 0.67	15	3.00 ± 0.62	15	2.78 ± 0.60	14	2.89 ± 0.80	14	3.21 ± 0.45
Information seeking	35	2.94 ± 0.94	29	3.10 ± 0.85	29	3.11 ± 0.98	27	2.90 ± 0.95	27	2.92 ± 1.02
IG	17	2.96 ± 1.05	14	3.02 ± 0.96	14	3.21 ± 0.89	13	2.83 ± 0.83	13	2.58 ± 1.13
CG	18	2.92 ± 0.86	15	3.18 ± 0.75	15	3.02 ± 1.08	14	2.96 ± 1.08	14	3.23 ± 0.81
Planning content	35	2.89 ± 1.04	29	2.98 ± 0.81	29	3.29 ± 0.99	27	2.74 ± 1.03	27	2.89 ± 0.92
IG	17	2.85 ± 1.07	14	3.07 ± 0.73	14	3.71 ± 0.78	13	2.69 ± 0.78	13	2.69 ± 0895
CG	18	2.92 ± 1.03	15	2.90 ± 0.89	15	2.90 ± 1.04	14	2.79 ± 1.25	14	3.07 ± 0.98
Regulation: Allowances	35	2.69 ± 0.91	29	2.79 ± 0.84	29	2.79 ± 0.69	27	2.69 ± 0.75	27	2.54 ± 0.62
IG	17	2.65 ± 0.81	14	2.89 ± 0.45	14	3.00 ± 0.55	13	2.85 ± 0.77	13	2.54 ± 0.72
CG	18	2.72 ± 1.02	15	2.70 ± 1.09	15	2.60 ± 0.76	14	2.54 ± 0.72	14	2.54 ± 0.54
Regulation: Restrictions	35	2.74 ± 0.77	29	2.91 ± 0.58	29	3.09 ± 0.65	27	2.79 ± 0.69	27	2.72 ± 0.65
IG	17	2.67 ± 0.77	14	2.95 ± 0.41	14	3.21 ± 0.66	13	2.87 ± 0.46	13	2.74 ± 0.73
CG	18	2.81 ± 0.79	15	2.87 ± 0.71	15	2.98 ± 0.65	14	2.71 ± 0.87	14	2.69 ± 0.59
Regulation: Rule setting	35	2.40 ± 0.84	29	2.76 ± 0.76	29	2.98 ± 0.74	27	2.61 ± 0.94	27	2.76 ± 0.87
IG	17	2.15 ± 0.77	14	2.86 ± 0.60	14	3.36 ± 0.66	13	2.50 ± 0.65	13	2.73 ± 0.86
CG	18	2.64 ± 0.85	15	2.67 ± 0.91	15	2.63 ± 0.64	14	2.71 ± 1.17	14	2.79 ± 0.91
Restraint	35	2.37 ± 0.83	29	2.40 ± 0.85	29	2.26 ± 0.84	27	2.46 ± 1.07	27	2.54 ± 1.01
IG	17	2.29 ± 0.75	14	2.54 ± 0.84	14	2.36 ± 0.93	13	2.34 ± 0.88	13	2.42 ± 0.99
CG	18	2.44 ± 0.92	15	2.27 ± 0.86	15	2.17 ± 0.77	14	2.57 ± 1.25	14	2.64 ± 1.05

(*Continued*)

Table 3. Continued.

Variables	T0 – Baseline Pre-intervention		T1 Mid-way assessment		T2 Post-intervention		T3 3-month follow-up		T4 6-month follow-up	
	n	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*
Scheduling of diet and activity	35	2.59 ± 0.87	29	2.64 ± 0.83	29	2.72 ± 0.69	27	2.62 ± 0.85	27	2.64 ± 0.64
IG	17	2.67 ± 0.97	14	2.90 ± 0.78	14	2.95 ± 0.73	13	2.49 ± 0.48	13	2.56 ± 0.61
CG	18	2.52 ± 0.79	15	2.40 ± 0.83	15	2.51 ± 0.60	14	2.74 ± 1.09	14	2.71 ± 0.68
Self-monitoring	35	2.03 ± 0.96	29	2.46 ± 0.93	29	2.32 ± 0.90	27	2.32 ± 0.96	27	2.30 ± 0.99
IG	17	1.96 ± 1.01	14	2.24 ± 0.92	14	2.57 ± 0.90	13	2.15 ± 0.75	13	1.97 ± 0.71
CG	18	2.09 ± 0.94	15	2.67 ± 0.92	15	2.09 ± 0.86	14	2.48 ± 1.13	14	2.60 ± 1.13
Stimulus control	35	2.46 ± 0.96	29	2.74 ± 0.85	29	2.66 ± 0.86	27	2.56 ± 0.94	27	2.61 ± 0.99
IG	17	2.32 ± 1.13	14	2.79 ± 0.93	14	2.89 ± 0.81	13	2.34 ± 0.72	13	2.58 ± 0.91
CG	18	2.58 ± 0.77	15	2.70 ± 0.80	15	2.43 ± 0.86	14	2.75 ± 1.11	14	2.64 ± 1.01
Support: Help from others	35	2.23 ± 0.92	29	2.28 ± 0.82	29	2.14 ± 0.70	27	2.02 ± 0.76	27	2.12 ± 0.81
IG	17	2.20 ± 1.08	14	2.19 ± 0.65	14	2.29 ± 0.57	13	2.08 ± 0.63	13	2.08 ± 0.90
CG	18	2.26 ± 0.77	15	2.36 ± 0.97	15	2.00 ± 0.77	14	1.98 ± 0.80	14	2.17 ± 0.74
Support: Motivational	35	1.99 ± 0.73	29	2.23 ± 0.91	29	2.26 ± 0.91	27	1.95 ± 0.84	27	2.07 ± 0.77
IG	17	1.92 ± 0.81	14	2.33 ± 0.95	14	2.71 ± 0.93	13	2.03 ± 0.80	13	2.18 ± 0.85
CG	18	2.06 ± 0.65	15	2.13 ± 0.90	15	1.84 ± 0.74	14	1.88 ± 0.89	14	1.98 ± 0.71
Subjective well-being ($1.60 \leq Sk \leq 0.20$; $1.97 \leq Ku \leq 1.69$)										
Satisfaction with Life	35	3.32 ± 0.78	29	3.43 ± 0.75	29	3.61 ± 0.63	27	3.54 ± 0.63	27	3.48 ± 0.78
IG	17	3.12 ± 0.58	14	3.41 ± 0.58	14	3.56 ± 0.50	13	3.46 ± 0.66	13	3.38 ± 0.92
CG	18	3.51 ± 0.91	15	3.44 ± 0.89	15	3.65 ± 0.75	14	3.61 ± 0.73	14	3.57 ± 0.65
Positive Affect	35	3.32 ± 0.90	29	3.52 ± 0.74	29	3.54 ± 0.63	27	3.41 ± 0.86	27	3.45 ± 0.91
IG	17	3.48 ± 0.94	14	3.50 ± 0.75	14	3.79 ± 0.53	13	3.46 ± 1.01	13	3.46 ± 1.06
CG	18	3.17 ± 0.86	15	3.55 ± 0.75	15	3.31 ± 0.64	14	3.36 ± 0.72	14	3.44 ± 0.79
Negative affect	35	1.71 ± 0.74	29	1.52 ± 0.48	29	1.52 ± 0.47	27	1.69 ± 0.67	27	1.75 ± 0.81
IG	17	1.62 ± 0.49	14	1.53 ± 0.54	14	1.40 ± 0.42	13	1.72 ± 0.66	13	1.85 ± 0.90
CG	18	1.79 ± 0.92	15	1.52 ± 0.44	15	1.64 ± 0.51	14	1.66 ± 0.69	14	1.66 ± 0.75
Weight										
Weight	35	81.10 ± 10.69	29	79.95 ± 11.32	29	79.90 ± 10.47	27	79.87 ± 11.44	27	78.53 ± 11.44
IG	17	80.71 ± 11.43	14	80.38 ± 10.42	14	79.25 ± 10.55	13	79.02 ± 10.55	13	76.68 ± 10.94
CG	18	80.75 ± 9.67	15	79.82 ± 13.26	15	80.32 ± 11.10	14	80.66 ± 11.71	14	81.23 ± 11.91
Eating behaviour ($1.29 \leq Sk \leq 1.29$; $-1.23 \leq Ku \leq 1.91$)										
Emotional eating	35	2.35 ± 0.78	29	2.01 ± 0.68	29	2.08 ± 0.69	27	1.77 ± 0.62	27	1.98 ± 0.69
EC	17	2.56 ± 0.87	14	1.99 ± 0.81	14	1.92 ± 0.75	13	1.63 ± 0.71	13	1.88 ± 0.71
CG	18	2.15 ± 0.66	15	2.03 ± 0.56	15	2.23 ± 0.61	14	1.92 ± 0.51	14	2.06 ± 0.69
Cognitive restraint	35	2.66 ± 0.62	29	2.81 ± 0.57	29	2.89 ± 0.47	27	2.90 ± 0.65	27	2.82 ± 0.62
EC	17	2.70 ± 0.70	14	3.08 ± 0.43	14	3.14 ± 0.41	13	3.04 ± 0.52	13	2.91 ± 0.53
CG	18	2.63 ± 0.57	15	2.56 ± 0.58	15	2.66 ± 0.42	14	2.76 ± 0.74	14	2.74 ± 0.70
Uncontrolled eating	35	2.20 ± 0.64	29	2.12 ± 0.55	29	1.90 ± 0.48	27	1.84 ± 0.63	27	1.92 ± 0.63
IG	17	2.30 ± 0.63	14	2.03 ± 0.38	14	1.77 ± 0.41	13	1.73 ± 0.63	13	1.78 ± 0.58
CG	18	2.11 ± 0.65	15	2.21 ± 0.67	15	2.01 ± 0.53	14	1.94 ± 0.64	14	2.06 ± 0.67

(*Continued*)

Table 3. Continued.

Variables	T0 – Baseline Pre-intervention		T1 Mid-way assessment		T2 Post-intervention		T3 3-month follow-up		T4 6-month follow-up	
	n	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*
Physical activity										
Total physical activity (METs.min. week)	33	3492.53 ± 4317.91	29	3070.59 ± 2894.14	27	4372.17 ± 2951.09	23	7176.85 ± 8246.29	26	5308.81 ± 6657.53
IG	14	2752.57 ± 2781.46	14	3789.96 ± 3358.01	14	4580.46 ± 3078.29	11	6121.09 ± 5676.28	12	2466.50 ± 1477.02
CG	17	4339.15 ± 5399.68	15	2399.17 ± 2297.98	13	4147.85 ± 2915.25	12	8144.63 ± 10286.20	14	7745.07 ± 8339.11
Vigorous physical activity (METs.min/ week)	11	1974.55 ± 2438.90	11	1294.55 ± 970.65	14	1920 ± 1409.68	9	4080 ± 4122.14	15	2434.67 ± 2888.36
IG	4	2160 ± 1269.96	5	1528 ± 1149.05	10	2040 ± 1641.46	4	4200 ± 4227.91	5	1592 ± 947.59
CG	7	1868.57 ± 3011.86	6	1100 ± 853.32	4	1620 ± 600	5	3984 ± 4533.39	10	2856 ± 3462.16
Moderate physical activity (METs. min/week)	28	2062.14 ± 3228.79	26	1789.23 ± 2007.84	25	2361.60 ± 1925.53	20	3897 ± 6133.78	21	3133.33 ± 3941.86
IG	13	1264.62 ± 1273.37	12	2293.33 ± 2273.28	13	2326.15 ± 2182.95	10	2430 ± 2097.09	10	1148 ± 892.25
CG	15	2753.33 ± 4196.81	14	1357.14 ± 1715.91	12	2400 ± 1699.37	10	5364 ± 8381.32	11	4938.18 ± 4778.63
Walking (METs.min/week)	29	1234.26 ± 1598.26	26	1087.96 ± 987.31	21	1338.69 ± 1202.50	19	2520.38 ± 3312.08	18	1879.42 ± 1884.47
IG	13	1262.15 ± 1850.12	13	1376.88 ± 1119.37	12	1123.88 ± 1074.74	9	2914.67 ± 4309.92	6	1693 ± 1564.17
CG	16	1211.59 ± 1424.32	13	799.04 ± 772.61	12	1553.50 ± 1329.56	11	2197.77 ± 2393.33	13	1965.46 ± 2069.30
Sedentary behaviour (h/week/ weekend)	35	35.91 ± 14.83	29	40.74 ± 21.98	29	38.69 ± 15.89	27	37.33 ± 25.38	27	39.31 ± 19.72
IG	17	37.08 ± 14.61	14	35.59 ± 17.21	14	37.50 ± 17.62	13	41.62 ± 29.90	13	38.25 ± 21.62
CG	18	34.81 ± 15.37	15	45.55 ± 25.31	15	39.80 ± 14.63	14	33.36 ± 23.11	14	40.29 ± 18.56
HBM - Health beliefs ($-2.50 \leq Sk \leq 1.94$; $-2.06 \leq Ku \leq 6.74$)										
Perceived susceptibility	35	3.58 ± 0.62	29	3.56 ± 0.72	29	3.56 ± 0.79	27	3.58 ± 0.74	27	3.52 ± 0.74
IG	17	3.63 ± 0.75	14	3.71 ± 0.79	14	3.67 ± 0.86	13	3.54 ± 0.67	13	3.41 ± 0.92
CG	18	3.54 ± 0.49	15	3.42 ± 0.64	15	3.47 ± 0.73	14	3.62 ± 0.55	14	3.62 ± 0.52
Perceived severity	35	3.56 ± 0.65	29	3.58 ± 0.72	29	3.65 ± 0.51	27	3.61 ± 0.51	27	3.48 ± 0.61
IG	17	3.69 ± 0.74	14	3.70 ± 0.64	14	3.82 ± 0.43	13	3.64 ± 0.54	13	3.47 ± 0.62
CG	18	3.44 ± 0.56	15	3.48 ± 0.79	15	3.49 ± 0.55	14	3.58 ± 0.50	14	3.49 ± 0.63
Perceived barriers	35	2.62 ± 0.65	29	2.40 ± 0.61	29	2.31 ± 0.64	27	2.45 ± 0.66	27	2.30 ± 0.59
IG	17	2.43 ± 0.65	14	2.20 ± 0.51	14	1.91 ± 0.50	13	2.29 ± 0.70	13	2.08 ± 0.62
CG	18	2.80 ± 0.62	15	2.58 ± 0.66	15	2.68 ± 0.53	14	2.59 ± 0.60	14	2.50 ± 0.50
Perceived benefits	35	3.83 ± 0.71	29	3.98 ± 0.61	29	3.96 ± 0.66	27	3.92 ± 0.57	27	3.87 ± 0.60
IG	17	4.02 ± 0.59	14	4.00 ± 0.56	14	4.16 ± 0.61	13	3.88 ± 0.57	13	3.85 ± 0.62
CG	18	3.65 ± 0.78	15	3.96 ± 0.67	15	3.77 ± 0.67	14	3.95 ± 0.59	14	3.88 ± 0.60
Cues to action	35	3.34 ± 0.50	29	3.25 ± 0.73	29	3.27 ± 0.70	27	3.33 ± 0.59	27	3.23 ± 0.66
IG	17	3.29 ± 0.41	14	3.09 ± 0.54	14	3.26 ± 0.63	13	3.32 ± 0.50	13	3.16 ± 0.70
CG	18	3.39 ± 0.59	15	3.39 ± 0.86	15	3.27 ± 0.78	14	3.35 ± 0.68	14	3.30 ± 0.63
HAPA - Behavioural change determinants ($-2.33 \leq Sk \leq 0.90$; $-1.80 \leq Ku \leq 6.94$)										
Risk perception	35	3.75 ± 0.50	29	3.76 ± 0.60	29	3.75 ± 0.69	27	3.80 ± 0.51	27	3.73 ± 0.59
IG	17	3.82 ± 0.62	14	3.93 ± 0.66	14	3.88 ± 0.73	13	3.81 ± 0.53	13	3.67 ± 0.72
CG	18	3.68 ± 0.35	15	3.63 ± 0.52	15	3.63 ± 0.65	14	3.79 ± 0.51	14	3.79 ± 0.46

(*Continued*)

Table 3. Continued.

	T0 – Baseline Pre-intervention		T1 Mid-way assessment		T2 Post-intervention		T3 3-month follow-up		T4 6-month follow-up	
Variables	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*	*n*	*M* ± *SD*
Action self-efficacy	35	3.63 ± 0.60	29	3.69 ± 0.59	29	3.71 ± 0.64	27	3.63 ± 0.61	27	3.69 ± 0.59
IG	17	3.65 ± 0.72	14	3.71 ± 0.75	14	3.91 ± 0.62	13	3.59 ± 0.74	13	3.73 ± 0.67
CG	18	3.62 ± 0.48	15	3.67 ± 0.43	15	3.53 ± 0.62	14	3.66 ± 0.49	14	3.65 ± 0.52
Outcome expectancies	35	4.35 ± 0.49	29	4.35 ± 0.48	29	4.29 ± 0.63	27	4.26 ± 0.45	27	4.23 ± 0.61
IG	17	4.45 ± 0.45	14	4.64 ± 0.34	14	4.63 ± 0.37	13	4.35 ± 0.38	13	4.42 ± 0.61
CG	18	4.25 ± 0.52	15	4.08 ± 0.43	15	3.96 ± 0.67	14	4.18 ± 0.51	14	4.05 ± 0.57
Action planning	35	3.76 ± 0.69	29	3.77 ± 0.62	29	3.74 ± 0.86	27	3.79 ± 0.66	27	3.48 ± 0.93
IG	17	3.79 ± 0.46	14	3.96 ± 0.45	14	4.19 ± 0.64	13	3.88 ± 0.70	13	3.57 ± 1.01
CG	18	3.73 ± 0.87	15	3.60 ± 0.72	15	3.33 ± 0.84	14	3.71 ± 0.64	14	3.40 ± 0.87
Coping planning	35	3.14 ± 0.84	29	3.30 ± 0.86	29	3.70 ± 0.80	27	3.56 ± 0.64	27	3.50 ± 0.94
IG	17	3.18 ± 0.90	14	3.59 ± 0.69	14	4.09 ± 0.64	13	3.63 ± 0.65	13	3.51 ± 0.96
CG	18	3.10 ± 0.80	15	3.03 ± 0.95	15	3.33 ± 0.77	14	3.49 ± 0.64	14	3.49 ± 0.95
Maintenance self-efficacy	35	3.69 ± 0.66	29	3.74 ± 0.63	29	3.79 ± 0.73	27	3.76 ± 0.59	27	3.83 ± 0.73
IG	17	3.62 ± 0.82	14	3.77 ± 0.68	14	4.05 ± 0.71	13	3.67 ± 0.72	13	3.77 ± 0.91
CG	18	3.75 ± 0.48	15	3.72 ± 0.60	15	3.55 ± 0.69	14	3.84 ± 0.47	14	3.89 ± 0.55
Intention	35	3.71 ± 0.73	29	4.03 ± 0.77	29	3.93 ± 0.79	27	3.93 ± 0.88	27	3.93 ± 0.84
IG	17	3.69 ± 0.79	14	4.33 ± 0.68	14	4.43 ± 0.50	13	4.15 ± 0.92	13	4.15 ± 0.66
CG	18	3.74 ± 0.68	15	3.76 ± 0.77	15	3.47 ± 0.73	14	3.74 ± 0.82	14	3.71 ± 0.95
Recovery self-efficacy	35	4.03 ± 0.73	29	4.15 ± 0.61	29	3.87 ± 0.72	27	4.00 ± 0.65	27	4.14 ± 0.51
IG	17	3.94 ± 0.87	14	4.31 ± 0.56	14	4.31 ± 0.46	13	4.05 ± 0.85	13	4.23 ± 0.60
CG	18	4.11 ± 0.58	15	4.00 ± 0.63	15	3.47 ± 0.68	14	3.95 ± 0.41	14	4.05 ± 0.41
Action control	35	3.79 ± 0.73	29	3.99 ± 0.82	29	3.84 ± 0.73	27	3.74 ± 0.86	27	3.67 ± 0.85
IG	17	3.91 ± 0.59	14	4.38 ± 0.66	14	4.29 ± 0.43	13	3.83 ± 0.83	13	3.83 ± 0.91
CG	18	3.68 ± 0.85	15	3.63 ± 0.81	15	3.42 ± 0.72	14	3.66 ± 0.91	14	3.52 ± 0.79
	Self-esteem ($-2.16 \leq Sk \leq 0.51$; $-2.07 \leq Ku \leq 5.16$)									
Self-esteem	35	22.63 ± 4.80	29	23.28 ± 3.84	29	24.21 ± 4.40	27	23.04 ± 4.55	27	23.52 ± 4.69
IG	17	21.94 ± 4.80	14	23.57 ± 3.61	14	24.64 ± 3.82	13	24.08 ± 4.63	13	23.38 ± 5.08
CG	18	23.00 ± 5.30	15	23.00 ± 4.16	15	23.80 ± 4.99	14	22.07 ± 4.43	14	23.64 ± 4.48

Legend: Sk (Skewness); Ku (Kurtosis); IG (Intervention group); CG (Control group).

Table 4. Latent Growth Models to test the interindividual effectiveness of the ME-WEL intervention in the primary and secondary measures, in both groups (Intervention and Control groups).

Outcome measures	Group	Goodness of fit X2(df)	T0 mean (*SE*)	Slope (*SE*)	*p*-value slope	CFI	TLI	RMSEA (95%CI)*1	SRMR*1
			Weight management strategies						
Energy compensation	**IG**	**(X^2(8)=5.312;*p* = 0.724)**	**2.508 (0.196)**	**0.648 (0.333)**	**0.052**	**1.000**	**1.000**	**0.000 (0.000 to 0.251)**	**0.153**
	CG	**(X^2(7)=8.569;*p* = 0.285)**	**2.577 (0.240)**	**0.248 (0.119)**	**0.037**	**0.953**	**0.933**	**0.131 (0.000 to 0.000)**	**0.093**
Goal setting	**IG**	**(X^2(7)=9.079;*p* = 0.248)**	**2.836 (0.143)**	**0.512 (0.171)**	**0.003**	**0.913**	**0.876**	**0.140 (0.000 to 0.366)**	**0.169**
	CG	(X^2(11)=15.527;*p* = 0.160)	2.524 (0.245)	0.036 (0.060)	0.546	0.893	0.903	0.178 (0.000 to 0.000)	0.110
Imitation: Modelling	IG	(X^2(8)=9.314;*p* = 0.316)	2.006 (0.132)	0.000 (0.006)	0.934	0.922	0.902	0.117 (0.000 to 0.371)	0.188
	CG	(X^2(7)=1.299;*p* = 0.988)	1.903 (0.210)	0.013 (0.156)	0.935	1.000	1.000	0.000 (0.000 to 0.000)	0.083
Impulse management:	**IG**	**(X^2(7)=0.449;*p* = 1.000)**	**3.249 (0.140)**	**0.469 (0.131)**	**<0.001**	**1.000**	**1.000**	**0.000 (0.000 to 0.000)**	**0.046**
Acceptance	CG	(X^2(7)=5.728;*p* = 0.572)	2.870 (0.189)	0.055 (0.061)	0.371	0.936	0.936	0.111 (0.000 to 0.332)	0.149
Impulse management:	IG	(X^2(7)=7.792;*p* = 0.351)	3.132 (0.211)	0.163 (0.131)	0.214	0.948	0.926	0.097 (0.000 to 0.377)	0.137
Awareness of motives	CG	(X^2(7)=0.808;*p* = 0.997)	3.125 (0.166)	0.019 (0.069)	0.781	1.000	1.000	0.000 (0.000 to 0.000)	0.060
Impulse management:	**IG**	**(X^2(7)=4.938;*p* = 0.668)**	**2.485 (0.179)**	**0.721 (0.208)**	**0.001**	**1.000**	**1.000**	**0.000 (0.000 to 0.283)**	**0.136**
Distraction	**CG**	**(X^2(8)=8.107;*p* = 0.423)**	**2.550 (0.202)**	**0.361 (0.159)**	**0.023**	**0.993**	**0.992**	**0.032 (0.000 to 0.328)**	**0.134**
Information seeking	IG	(X^2(11)=4.838;*p* = 0.939)	3.062 (0.210)	−0.080 (0.049)	0.100	1.000	1.000	0.000 (0.000 to 0.069)	0.133
	CG	(X^2(7)=7.225;*p* = 0.406)	3.030 (0.248)	0.133 (0.184)	0.469	0.994	0.992	0.050 (0.000 to 0.347)	0.076
Planning content	**IG**	**(X^2(7)=6.812;*p* = 0.449)**	**2.920 (0.220)**	**0.730 (0.179)**	**<0.001**	**1.000**	**1.000**	**0.000 (0.000 to 0.349)**	**0.172**
	CG	(X^2(8)=9.036;*p* = 0.339)	2.885 (0.292)	0.128 (0.221)	0.562	0.967	0.959	0.100 (0.000 to 0.350)	0.077
Regulation: Allowances	IG	(X^2(10)=5.909;*p* = 0.823)	2.993 (0.097)	−0.075 (0.055)	0.176	1.000	1.000	0.000 (0.000 to 0.191)	0.147
	CG	(X^2(10)=5.078;*p* = 0.886)	2.759 (0.229)	−0.058 (0.059)	0.326	1.000	1.000	0.000 (0.000 to 0.143)	0.130
Regulation: Restrictions	**IG**	**(X^2(7)=7.378;*p* = 0.391)**	**2.880 (0.134)**	**0.258 (0.068)**	**<0.001**	**0.982**	**0.975**	**0.064 (0.000 to 0.351)**	**0.178**
	CG	**(X^2(11)=11.336;*p* = 0.416)**	**2.948 (0.165)**	**−0.057 (0.029)**	**0.054**	**0.960**	**0.964**	**0.048 (0.000 to 0.297)**	**0.157**
Regulations: Rule setting	**IG**	**(X^2(8)=6.048;*p* = 0.642)**	**2.186 (0.221)**	**0.501 (0.231)**	**0.030**	**1.000**	**1.000**	**0.000 (0.000 to 0.279)**	**0.158**
	CG	(X^2(11)=11.989;*p* < 0.001)	2.653 (0.225)	0.022 (0.062)	0.725	0.956	0.960	0.083 (0.000 to 0.309)	0.125
Restraint	IG	(X^2(11)=12.342;*p* = 0.338)	2.389 (0.156)	−0.007 (0.916)	0.191	0.891	0.901	0.101 (0.000 to 0.329)	0.146
	CG	(X^2(7)=7.311;*p* = 0.397)	2.472 (0.241)	0.017 (0.362)	0.963	0.985	0.978	0.058 (0.000 to 0.350)	0.121
Scheduling of diet and activity	IG	(X^2(7)=9.921;*p* = 0.193)	2.688 (0.224)	−0.127 (0.146)	0.385	0.971	0.964	0.142 (0.000 to 0.326)	0.141
	CG	(X^2(10)=11.442;*p* = 0.324)	2.415 (0.202)	0.081 (0.055)	0.139	0.950	0.950	0.092 (0.000 to 0.287)	0.327
Self-monitoring	**IG**	**(X^2(7)=7.693;*p* = 0.360)**	**1.821 (0.192)**	**0.647 (0.264)**	**0.014**	**0.921**	**0.887**	**0.091 (0.000 to 0.374)**	**0.086**
	CG	(X^2(7)=7.886;*p* = 0.343)	2.049 (0.291)	0.511 (0.366)	0.163	0.939	0.913	0.099 (0.000 to 0.365)	0.115
Stimulus control	**IG**	**(X^2(7)=0.916;*p* = 0.996)**	**2.316 (0.241)**	**0.574 (0.217)**	**0.008**	**1.000**	**1.000**	**0.000 (0.000 to 0.000)**	**0.071**
	CG	(X^2(7)=7.588;*p* = 0.370)	2.540 (0.195)	0.118 (0.357)	0.748	0.944	0.920	0.080 (0.000 to 0.357)	0.101
Support: Help from others	IG	(X^2(7)=7.874;*p* = 0.344)	2.146 (0.154)	−0.009 (0.028)	0.735	0.915	0.879	0.102 (0.000 to 0.379)	0.145
	CG	(X^2(7)=9.884;*p* = 0.195)	2.134 (0.170)	0.021 (0.106)	0.840	0.901	0.858	0.178 (0.000 to 0.000)	0.110
Support: Motivational	**IG**	**(X^2(7)=3.099;*p* = 0.876)**	**1.951 (0.199)**	**0.646 (0.119)**	**<0.001**	**1.000**	**1.000**	**0.000 (0.000 to 0.177)**	**0.111**
	CG	(X^2(11)=11.144;*p* = 0.431)	1.997 (0.159)	−0.014 (0.047)	0.767	0.989	0.990	0.032 (0.000 to 0.294)	0.165
			Subjective well-being						
Satisfaction with life	**IG**	**(X^2(8)=3.217;*p* = 0.920)**	**3.274 (0.113)**	**0.234 (0.124)**	**0.059**	**1.000**	**1.000**	**0.000 (0.118 to 0.926)**	**0.150**
	CG	(X^2(8)=0.795;*p* = 0.999)	3.571 (0.261)	0.038 (0.114)	0.741	0.973	0.961	0.080 (0.000 to 0.357)	0.052
Positive Affect	IG	(X^2(10)=10.867;*p* = 0.368)	3.597 (0.154)	0.001 (0.046)	0.979	0.933	0.933	0.085 (0.000 to 0.331)	0.195
	CG	(X^2(8)=1.157;*p* = 0.997)	3.204 (0.208)	0.057 (0.052)	0.274	1.000	1.000	0.00 (0.000 to 0.997)	0.073

(*Continued*)

Table 4. Continued.

Outcome measures	Group	Goodness of fit X2(df)	T0 mean (*SE*)	Slope (*SE*)	*p*-value slope	CFI	TLI	RMSEA (95%CI)[*1]	SRMR[*1]
Negative Affect	IG	(X^2(11)=14.081;p = 0.229)	1.479 (0.130)	0.040 (0.043)	0.353	0.892	0.902	0.153 (0.000 to 0.358)	0.227
	CG	(X^2(10)=15.211;p = 0.125)	1.697 (0.213)	−0.035 (0.076)	0.640	1.000	1.000	0.000 (0.000 to 0.999)	0.076
				Weight					
Weight	**IG**	**(X^2(8)=19.472;p = 0.013)**	**80.862 (2.775)**	**−5.086 (1.872)**	**0.007**	**0.931**	**0.913**	**0.353 (0.218 to 0.449)**	**0.047**
	CG	(X^2(11)=34.549;p < 0.001)	82.086 (2.765)	−0.482 (0.306)	0.115	0.905	0.914	0.370 (0.235 to 0.512)	0.031
				Eating behaviour					
Emotional eating	**IG**	**(X^2(8)=8.567;p = 0.380)**	**2.632 (0.256)**	**−0.797 (0.270)**	**0.003**	**0.953**	**0.942**	**0.077 (0.000 to 0.353)**	**0.118**
	CG	**(X^2(8)=0.436;p = 1.000)**	**2.003 (0.194)**	**0.216 (0.100)**	**0.030**	**1.000**	**1.000**	**0.000 (0.000 to 0.000)**	**0.046**
Cognitive restraint	IG	(X^2(11)=4.336;p = 0.959)	2.999 (0.117)	0.008 (0.020)	0.707	1.000	1.000	0.107 (0.000 to 0.331)	0.159
	CG	(X^2(11)=2.523;p = 0.996)	2.574 (0.155)	0.049 (0.043)	0.255	1.000	1.000	0.000 (0.000 to 0.000)	0.141
Uncontrolled eating	**IG**	**(X^2(7)=0.589;p = 0.999)**	**2.402 (0.166)**	**−0.635 (0.180)**	**<0.001**	**1.000**	**1.000**	**0.000 (0.000 to 0.000)**	**0.084**
	CG	**(X^2(7)=12.676;p = 0.080)**	**2.157 (0.161)**	**0.130 (0.057)**	**0.023**	**0.919**	**0.885**	**0.241 (0.000 to 0.449)**	**0.117**
				Physical activity					
Total physical activity (METs.min.week)	**IG**	**(X^2(7)=13.644;p = 0.058)**	**1964.805 (394.934)**	**309.880 (98.626)**	**0.002**	**0.842**	**0.775**	**0.270 (0.141 to 0.394)**	**0.385**
	CG	**(X^2(10)=11.029;p = 0.355)**	**1762.917(900.781)**	**1160.218 (346.941)**	**0.001**	**0.939**	**0.939**	**0.086 (0.000 to 0.227)**	**0.329**
Vigorous physical activity (METs.min/week)	IG	(X^2(7)=7.300;p = 0.398)	515.633 (298.534)	106.884 (113.912)	0.938	0.939	0.913	0.060 (0.000 to 0.363)	0.279
	CG	(X^2(8)=13.962;p = 0.083)	282.857 (120.973)	247.278 (158.574)	0.118	0.922	0.902	0.200 (0.000 to 0.370)	0.113
Moderate physical activity (METs.min/week)	IG	(X^2(8)=14.389;p = 0.072)	1006.155 (351.945)	−62.771 (203.771)	0.758	0.858	0.828	0.248 (0.000 to 0.428)	0.493
	CG	**(X^2(10)=25.338;p = 0.005)**	**949.734 (584.013)**	**608.986 (273.810)**	**0.026**	**0.858**	**0.828**	**0.331 (0.197 to 0.438)**	**0.302**
Walking (METs.min/week)	**IG**	**(X^2(8)=8.786;p = 0.361)**	**557.575 (186.066)**	**470.686 (247.862)**	**0.058**	**0.949**	**0.936**	**0.090 (0.000 to 0.358)**	**0.232**
	CG	(X^2(7)=6.442;p = 0.489)	783.154 (267.919)	1042.213 (1181.906)	0.378	1.000	1.000	0.000 (0.000 to 0.168)	0.320
Sedentary behaviour (h/week/weekend)	IG	(X^2(11)=13.301;p = 0.274)	36.235 (3.749)	0.704 (1.002)	0.482	0.950	0.954	0.100 (0.000 to 0.261)	0.099
	CG	(X^2(10)=10.464;p = 0.401)	37.240 (4.313)	0.473 (1.050)	0.653	0.973	0.973	0.060 (0.000 to 0.310)	0.130
				HBM - Health beliefs					
Perceived susceptibility	IG	(X^2(8)=1.476;p = 0.993)	3.568 (0.203)	−0.004 (0.761)	0.961	1.000	1.202	0.000 (0.000 to 0.000)	0.076
	CG	(X^2(8)=3.120;p = 0.927)	3.570 (0.118)	0.007 (0.183)	0.969	1.000	1.000	0.000 (0.000 to 0.102)	0.106
Perceived severity	**IG**	**(X^2(7)=8.138;p = 0.321)**	**3.510 (0.164)**	**0.254 (0.102)**	**0.012**	**0.974**	**0.963**	**0.112 (0.000 to 0.371)**	**0.125**
	CG	(X^2(7)=11.218;p = 0.129)	3.435 (0.131)	0.056 (0.131)	0.669	0.925	0.893	0.207 (0.000 to 0.423)	0.305
Perceived barriers	**IG**	**(X^2(8)=12.637;p = 0.125)**	**3.535 (0.182)**	**−0.487 (0.226)**	**0.031**	**0.905**	**0.881**	**0.211 (0.000 to 0.421)**	**0.119**
	CG	(X^2(11)=11.585;p = 0.396)	2.723 (0.178)	−0.049 (0.038)	0.197	0.958	0.962	0.064 (0.000 to 0.000)	0.091
Perceived benefits	**IG**	**(X^2(7)=8.758;p = 0.270)**	**3.853 (0.232)**	**0.213 (0.099)**	**0.031**	**0.957**	**0.938**	**0.139 (0.000 to 0.426)**	**0.243**
	CG	(X^2(8)=8.653;p = 0.372)	3.663 (0.170)	0.222 (0.184)	0.227	0.992	0.989	0.076 (0.000 to 0.329)	0.090
Cues to action	IG	(X^2(11)=11.659;p = 0.390)	3.314 (0.091)	−0.014 (0.038)	0.704	0.973	0.975	0.071 (0.000 to 0.316)	0.139
	CG	(X^2(11)=12.184;p = 0.350)	3.246 (0.117)	0.017 (0.031)	0.570	0.968	0.971	0.091 (0.000 to 0.000)	0.115
				HAPA - Behavioural change determinants					
Risk perception	IG	(X^2(7)=2.723;p = 0.909)	3.745 (0.124)	0.018 (0.118)	0.880	1.000	1.000	0.000 (0.000 to 0.130)	0.072
	CG	(X^2(7)=8.774;p = 0.269)	3.700 (0.066)	0.007 (0.130)	0.954	0.952	0.931	0.113 (0.000 to 0.312)	0.090
Action self-efficacy	**IG**	**(X^2(8)=6.044;p = 0.642)**	**3.494 (0.177)**	**0.371 (0.139)**	**0.008**	**1.000**	**1.000**	**0.000 (0.000 to 0.279)**	**0.073**
	CG	(X^2(11)=2.017;p = 0.998)	3.695 (0.109)	−0.017 (0.025)	0.491	1.000	1.000	0.000 (0.000 to 0.000)	0.087

(*Continued*)

Table 4. Continued.

Outcome measures	Group	Goodness of fit X2(df)	T0 mean (*SE*)	Slope (*SE*)	*p*-value slope	CFI	TLI	RMSEA (95%CI)[*1]	SRMR[*1]
Outcome expectancies	**IG**	**(X^2(8)=5.034;*p* = 0.754)**	**4.577 (0.102)**	**−0.219 (0.128)**	**0.088**	**1.000**	**1.000**	**0.000 (0.000 to 0.239)**	**0.132**
	CG	(X^2(11)=11.054;*p* = 0.439)	4.100 (0.122)	−0.005 (0.040)	0.902	0.998	0.998	0.019 (0.000 to 0.292)	0.139
Action planning	**IG**	**(X^2(7)=7.516;*p* = 0.377)**	**3.774 (0.085)**	**0.363 (0.181)**	**0.045**	**0.963**	**0.948**	**0.078 (0.000 to 0.370)**	**0.145**
	CG	(X^2(10)=11.036;*p* = 0.355)	3.592 (0.190)	−0.017 (0.048)	0.724	0.906	0.906	0.089 (0.000 to 0.322)	0.198
Coping planning	**IG**	**(X^2(7)=9.905;*p* = 0.194)**	**3.220 (0.245)**	**0.290 (0.143)**	**0.042**	**0.929**	**0.898**	**0.186 (0.000 to 0.429)**	**0.159**
	CG	**(X^2(8)=5.057;*p* = 0.751)**	**3.101 (0.181)**	**0.357 (0.202)**	**0.077**	**1.000**	**1.000**	**0.000 (0.000 to 0.231)**	**0.139**
Maintenance self-efficacy	**IG**	**(X^2(8)=9.337;*p* = 0.315)**	**3.399 (0.239)**	**0.547 (0.181)**	**0.002**	**0.942**	**0.928**	**0.118 (0.000 to 0.000)**	**0.101**
	CG	**(X^2(8)=0.677;*p* = 1.000)**	**3.812 (0.112)**	**−0.223 (0.135)**	**0.098**	**1.000**	**1.000**	**0.000 (0.000 to 0.000)**	**0.055**
Intention	**IG**	**X^2(8)=8.047;*p* = 0.429)**	**3.631 (0.202)**	**0.544 (0.192)**	**0.005**	**0.998**	**0.997**	**0.022 (0.000 to 0.340)**	**0.114**
	CG	(X^2(10)=11.371;*p* = 0.329)	3.745 (0.151)	−0.023 (0.056)	0.679	0.920	0.920	0.103 (0.000 to 0.328)	0.134
Recovery self-efficacy	**IG**	**(X^2(7)=1.872;*p* = 0.967)**	**4.017 (0.178)**	**0.276 (0.138)**	**0.046**	**1.000**	**1.000**	**0.000 (0.000 to 0.000)**	**0.072**
	CG	**(X^2(7)=1.657;*p* = 0.976)**	**4.134 (0.158)**	**−0.703 (0.208)**	**0.001**	**1.000**	**1.000**	**0.000 (0.000 to 0.000)**	**0.082**
Action control	**IG**	**(X^2(8)=8.317;*p* = 0.403)**	**3.896 (0.158)**	**0.395 (0.170)**	**0.020**	**0.968**	**0.960**	**0.057 (0.000 to 0.347)**	**0.117**
	CG	**(X^2(8)=8.110;*p* = 0.423)**	**3.687 (0.235)**	**−0.318 (0.184)**	**0.084**	**0.993**	**0.991**	**0.033 (0.000 to 0.328)**	**0.106**
			Self-esteem						
Self-esteem	**IG**	**(X^2(8)=9.868;*p* = 0.274)**	**22.531 (0.959)**	**1.633 (0.559)**	**0.003**	**0.982**	**0.978**	**0.098 (0.000 to 0.270)**	**0.109**
	CG	**(X^2(8)=7.216;*p* = 0.513)**	**23.851 (1.233)**	**−1.655 (0.932)**	**0.076**	**1.000**	**1.000**	**0.000 (0.000 to 0.304)**	**0.067**

Legend: IG (Intervention group); CG (Control Group); HBM (Health Belief Model); HAPA (Health Action Process Approach).
[*1]The RMSEA and SRMR values tend to be overestimated for models with few degrees of freedom, as is the case with these LGM.
The values in bold indicate that there are significant effects on the group's trajectories.

to 0.098) of *energy compensation, goal setting, imitation: modeling, impulse management: acceptance, impulse management: awareness of motives, information seeking, planning content, regulation: rule setting, restraint, scheduling of diet and activity, self-monitoring, stimulus control, support: help from others, support: motivational, negative affect, emotional eating, cognitive restraint, total physical activity, sedentary behaviour, weight, perceived susceptibility, perceived barriers, action self-efficacy, outcome expectancies, action planning, coping planning, maintenance self-efficacy, intention, recovery self-efficacy, action control,* and *self-esteem*.

Regarding the primary outcomes, there was an increase in the average implementation of certain weight management strategies, specifically, *regulation: rule setting* increased by 0.501 ($SE = 0.231$; $p = 0.030$) comparing T0-T4. Between T0-T2, *energy compensation* showed an average growth rate by 0.648 ($SE = 0.333$; $p = 0.052$), *goal setting* by 0.512 ($SE = 0.171$; $p = 0.003$), *impulse management: acceptance* by 0.469 ($SE = 0.131$; $p < 0.001$), *impulse management: distraction* by 0.721 ($SE = 0.208$; $p = 0.001$), *planning content* by 0.730 ($SE = 0.179$; $p < 0.001$), *regulation: restrictions* by 0.258 ($SE = 0.068$; $p < 0.001$), *self-monitoring* by 0.647 ($SE = 0.264$; $p = 0.014$), *stimulus control* by 0.574 ($SE = 0.217$; $p = 0.008$), and *support: motivational* by 0.646 ($SE = 0.119$; $p < 0.001$). No significant growth rates were found in *imitation: modeling*, *impulse management: awareness of motives*, *information seeking*, *regulation: allowances*, *restraint*, *scheduling of diet and activity*, and *support: help from others* (see Table 4). Regarding subjective well-being, there was a marginal average growth rate in *satisfaction with life* from T0-T3 by 0.234 ($SE = 0.124$; $p = 0.059$). No significant differences were found in both *negative* ($SE = 0.043$; $p = 0.353$) and *positive affect* ($SE = 0.046$; $p = 0.979$).

Concerning the secondary outcomes, the average weight loss in this group amounted to 4.150 kg between T0 and T4 ($SE = 1.493$; $p = 0.005$). Regarding eating behaviour, there was an average rate of decrease by 0.797($SE = 0.270$; $p = 0.003$) in *emotional eating* and 0.157($SE = 0.040$; $p < 0.001$) in *uncontrolled eating*, both from T0-T4. No significant differences were found in *cognitive restraint* ($SE = 0.020$; $p = 0.707$).

Concerning physical activity, *total physical activity* presented a growth rate of the average by 309.880 min per week ($SE = 98.626$; $p = 0.002$), and a marginally significant finding was found regarding the *walking* dimension, indicating a growth rate in the average weekly duration of walking by 470.686 min ($SE = 247.862$; $p = 0.058$), between T0-T4. No significant differences were found concerning *vigorous* and *moderate physical activity*, as well as *sedentary behaviour* (Table 4).

In the HBM, the average rate of *perceived barriers* regarding weight management decreased by 0.487 ($SE = 0.226$; $p = 0.031$) from T0-T4. These women showed an average growth rate by 0.254 ($SE = 0.102$; $p = 0.012$) in *perceived severity* and 0.213 ($SE = 0.099$; $p = 0.031$) in *perceived benefits* (T0-T2). No significant growth rates were found concerning *perceived susceptibility* and *cues to action* (Table 4).

In the HAPA model, there was an increase in *intention* from T0-T4, with an average rate of 0.544 ($SE = 0.192$; $p = 0.005$). Additionally, *coping planning* increased significantly from T0-T3, with an average increase by 0.290 ($SE = 0.143$; $p = 0.042$) and *outcome expectancies* showed a marginally significant decrease by 0.219 ($SE = 0.128$; $p = 0.088$). Regarding self-efficacy, all three dimensions showed a significant average growth rate between T0-T2: 0.371 ($SE = 0.147$; $p = 0.012$) in *action self-efficacy*, 0.547 ($SE = 0.181$; $p = 0.002$) in *maintenance self-efficacy*, and 0.276 ($SE = 0.138$; $p = 0.046$) in *recovery self-efficacy*. Also, there was a significant average growth between T0-T2 by 0.363

(*SE* = 0.181; *p* = 0.045) in *action planning* and 0.395 (*SE* = 0.170; *p* = 0.020) in *action control*. No significant growth was found in *risk perception* (*SE* = 0.086; *p* = 0.564).

Finally, there was a significant increase by 1.582 (*SE* = 0.726; *p* = 0.029) in *self-esteem* (T0-T3).

3.2.2. Control group

In the CG, the parameter estimates of the identified models below show non-significant variances (V(Intercept)=0.489 to 21.311, SE = 0.079 to 164.804, *p* = 0.150 to 1.000), suggesting no variability in the baseline values for *imitation: modeling, self-monitoring, stimulus control, support: help from others, total physical activity, walking, sedentary behaviour, risk perception, intention,* and *recovery self-efficacy*. Conversely, there was inter-variability in the baseline values (V(Intercept)=0.109 to 107.077, SE = 0.044 to 90.127, *p* < 0.001 to 0.098) of *energy compensation, goal setting, impulse management: acceptance, impulse management: awareness of motives, impulse management: distraction, information seeking, planning content, regulation: allowances, regulation: restrictions, regulation: rule setting, restraint, scheduling of diet and activity, support: motivational, satisfaction with life, positive affect, negative affect, emotional eating, uncontrolled eating, cognitive restraint, moderate physical activity, vigorous physical activity, weight, perceived susceptibility, perceived severity, perceived barriers, perceived benefits), cues to action, action self-efficacy, outcome expectancies, action planning, coping planning, maintenance self-efficacy, action control,* and *self-esteem*.

The CG showed a marginal decrease in *regulation: restrictions* strategies with an average decrease rate by 0.057 (*SE* = 0.029; *p* = 0.054) comparing T0-T4, and an increase in the average strategies implementation such as *energy compensation*, with an average growth rate by 0.248 (*SE* = 0.119; *p* = 0.037) comparing T0-T3, and *impulse management: distraction* by 0.361 (*SE* = 0.159; *p* = 0.023) between T0-T2. No significant growth rates were found concerning *goal setting*, *imitation: modeling*, *impulse management: acceptance, impulse management: awareness of motives*, *information seeking*, *planning content, regulation: allowances, regulation: rule setting*, *restraint*, *scheduling of diet and activity*, *self-monitoring*, *stimulus control*, *support: help from others*, and *support: motivational* (Table 4). Regarding subjective well-being, no significant growth rates were observed in *satisfaction with life*, *positive* and *negative affect* (Table 4).

Concerning the secondary outcome measures, there was no significant average evolution of weight over time (*SE* = 2.264; *p* = 0.844). Regarding eating behaviour, there was an average growth rate by 0.216 (*SE* = 0.100; *p* = 0.030) in *emotional eating* from T0-T2, and by 0.130 (*SE* = 0.057; *p* = 0.023) in *uncontrolled eating* between T0-T1. No significant difference was found in *cognitive restraint* (*SE* = 0.043; *p* = 0.255).

In physical activity, between T0-T4, the average growth rate of *total physical activity* increased by 1160.218 min per week (*SE* = 346.941; *p* = 0.001), as well as in *moderate physical activity* by 608.986 min (*SE* = 273.810; *p* = 0.026). No significant difference was found regarding *walking* (*SE* = 1181.906; *p* = 0.378), *vigorous physical activity* (*SE* = 158.574; *p* = 0.118), and *sedentary behaviour* (*SE* = 3.047; *p* = 0.664).

No significant growth rates were observed concerning the different dimensions of the HBM (Table 4). About the HAPA model, these women displayed an average reduction rate in *recovery self-efficacy* of 0.703 (*SE* = 0.208; *p* = 0.001) from T0-T2. Additionally, some significant results were found, including a reduction by 0.223 (*SE* = 0.119;

$p = 0.037$) in the average rate of *maintenance self-efficacy*, by 0.318 in *action control (SE* = 0.184; $p = 0.084$) both from T0-T2 and an average growth rate by 0.357 (*SE* = 0.202; $p = 0.077$) in *coping planning* from T0-T3, being the last two only marginally significant. No significant differences in average growth rates were found regarding *risk perception*, *action self-efficacy*, *outcome expectancies*, *action planning*, and *intention* (Table 4). A marginally significant average reduction rate in *self-esteem* by 1.655 (*SE = 0*.932; $p = 0.076$) was observed from T0-T3.

3.2.3. Intervention effects (interindividual) on primary and secondary outcomes, through conditional LGMs

The models fit for the measures were considered sufferable to good ($0.792 \leq$ CFI ≤ 1.000; $0.688 \leq$ TLI ≤ 1.000; $0.000 \leq$ RMSEA ≤ 0.304; $0.030 \leq$ SRMR ≤ 0.329; $X^2(10)=5.276$, $p = 0.872$ to $X^2(14)=18.329$, $p = 0.192$; Table 5).

Firstly, concerning the differences at baseline in the intercept of weight management strategies, a marginally significant difference was observed in *regulation: rule setting* (*B*= −0.516, *SE* = 0.266, $p = 0.053$), with the IG presenting lower initial levels than the CG. No other intercept differences were found among IG and CG (Table 5). There was a significant intervention effect on *regulation: rule setting*, where the IG demonstrated an increase in the use of this strategy from T0-T4 (*B* = 0.694, *SE* = 0.182, $p < 0.001$) with an effect size of 0.68. A similar trend was observed in *energy compensation*; however, with a marginally significant result (*B* = 0.270, *SE* = 0.158, $p = 0.086$), and an effect size of 0.67. The effect on the latent slope in *information seeking* is negative, demonstrating a significant increase in the use of this strategy in the CG (*B*= −0.684, *SE* = 0.314, $p = 0.029$) from T0-T4, with an effect size of −0.57. Between T0-T2, the IG demonstrated an increase in the growth rate in *goal setting*, *planning content*, and *support: motivational* (*B* = 0.519, *SE* = 0.264, $p = 0.049$; *B* = 0.762, *SE* = 0.366, $p = 0.037$; and *B* = 0.751, *SE* = 0.272, $p = 0.006$, respectively). The effect size was 0.71, 0.83, and 0.29, in the same order. Finally, no significant treatment effects were found regarding *imitation: modeling*, *impulse management: acceptance*, *impulse management: awareness of motives*, *rIGulation: allowances*, *rIGulation: restrictions*, *restraint*, *scheduling of diet and activity*, *self-monitoring*, *stimulus control*, and *support: help from others* (Table 5). Concerning subjective well-being, no significant intercept differences were found. The growth rate of *satisfaction with life* and *positive affect* in the IG between T0-T2 was marginally higher than in CG (*B* = 0.283, *SE* = 0.166, $p = 0.089$; *B* = 0.292, *SE* = 0.176, $p = 0.098$, respectively). The effect size was 0.10 and 0.49, in the same order. No significant differences were observed regarding *negative affect* (*B* = 0.092, *SE* = 0.166, $p = 0.580$).

Concerning eating behaviour, no significant intercept differences were found. There was a reduction in the latent growth rate in *emotional eating* (*B*= −0.727, *SE* = 0.253, $p = 0.004$) and *uncontrolled eating* (*B*= −0.376, *SE* = 0.186, $p = 0.044$), indicating a decrease in the IG, between T0-T4. The intervention effect size was −0.52 and −0.46, respectively. No significant treatment effects were found in *cognitive restraint* (*B*= −0.198, *SE* = 0.182, $p = 0.279$). Regarding physical activity, no significant differences were found in the intercepts. Concerning the effect of physical activity on the slopes, no intervention effects were found on different outcomes ($p > 0.558$), except for *sedentary*

Table 5. Conditional Latent Growth Models to analyze the effect of the groups (Intervention and Control groups) on the initial level (intercept) and change rate (slope).

Outcome measures	Intercept (SE)	*p*-value	Slope (SE)	*p*-value	Goodness of fit X^2(df)	CFI	TLI	RMSEA (95%CI)*1	SRMR*1
Weight management strategies									
Energy compensation	**−0.122 (0.315)**	**0.698**	**0.270 (0.158)**	**0.086**	**(X^2(11)=16.792; p=0.114)**	**0.901**	**0.866**	**0.123 (0.000 to 0.234)**	**0.125**
Goal setting	**0.176 (0.218)**	**0.418**	**0.519 (0.264)**	**0.049**	**(X^2(11)=18.176; p=0.078)**	**0.909**	**0.876**	**0.140 (0.000 to 0.250)**	**0.126**
Imitation: Modelling	0.258 (0.359)	0.473	−0.230 (0.656)	0.725	(X^2(10)=9.482; p=0.487)	1.000	1.000	0.000 (0.000 to 0.149)	0.085
Impulse management: Acceptance	0.105 (0.213)	0.623	0.035 (0.112)	0.751	(X^2(10)=15.313; p=0.121)	0.908	0.861	0.121 (0.000 to 0.235)	0.103
Impulse management: Awareness of motives	0.095 (0.270)	0.725	−0.453 (0.297)	0.127	(X^2(10)=5.276; p=0.872)	1.000	1.000	0.000 (0.000 to 0.090)	0.103
Impulse management: Distraction	−0.099 (0.653)	0.879	0.526 (0.811)	0.517	(X^2(10)=20.034; p=0.029)	0.792	0.688	0.193 (0.060 to 0.315)	0.154
Information seeking	**0.072 (0.311)**	**0.818**	**−0.684 (0.314)**	**0.029**	**(X^2(11)=9.641; p=0.563)**	**1.000**	**1.000**	**0.000 (0.000 to 0.151)**	**0.072**
Planning content	**−0.085 (0.416)**	**0.837**	**0.762 (0.366)**	**0.037**	**(X^2(10)=10.317; p=0.413)**	**0.996**	**0.994**	**0.027 (0.000 to 0.169)**	**0.115**
Regulation: Allowances	0.066 (0.280)	0.814	−0.242 (0.442)	0.584	(X^2(10)=13.195; p=0.213)	0.891	0.836	0.068 (0.000 to 0.155)	0.088
Regulation: Restrictions	−0.057 (0.220)	0.798	0.048 (0.067)	0.469	(X^2(13)=16.599; p=0.218)	0.865	0.844	0.089 (0.000 to 0.201)	0.140
Regulations: Rule setting	**−0.516 (0.266)**	**0.053**	**0.694 (0.182)**	**<0.001**	**(X^2(11)=8.875; p=0.633)**	**1.000**	**1.000**	**0.000 (0.000 to 0.155)**	**0.088**
Restraint	0.017 (0.246)	0.944	−0.288 (0.283)	0.309	(X^2(10)=12.996; p=0.224)	0.940	0.910	0.089 (0.000 to 0.208)	0.112
Scheduling of diet and activity	0.234 (0.274)	0.392	−0.096 (0.074)	0.196	(X^2(14)=17.074; p=0.252)	0.934	0.929	0.078 (0.000 to 0.188)	0.152
Self-monitoring	0.014 (0.251)	0.956	−0.131 (0.190)	0.490	(X^2(10)=19.821; p=0.031)	0.899	0.848	0.155 (0.045 to 0.255)	0.118
Stimulus control	0.005 (0.260)	0.985	−0.439 (0.326)	0.178	(X^2(10)=18.680; p=0.045)	0.876	0.814	0.126 (0.000 to 0.214)	0.137
Support: Help from others	−0.052 (0.271)	0.848	0.161 (0.499)	0.746	(X^2(10)=10.931; p=0.363)	0.984	0.976	0.044 (0.000 to 0.167)	0.071
Support: Motivational	**−0.071 (0.243)**	**0.771**	**0.751 (0.272)**	**0.006**	**(X^2(11)=20.869; p=0.035)**	**0.886**	**0.845**	**0.138 (0.000 to 0.227)**	**0.101**
Subjective well-being									
Satisfaction with life	**−0.415 (0.285)**	**0.146**	**0.283 (0.166)**	**0.089**	**(X^2(10)=15.796;p=0.106)**	**0.964**	**0.946**	**0.110 (0.000 to 0.208)**	**0.092**
Positive Affect	**0.149 (0.254)**	**0.557**	**0.292 (0.176)**	**0.098**	**(X^2(10)=24.800;p=0.006)**	**0.903**	**0.855**	**0.151 (0.077 to 0.2427**	**0.110**
Negative Affect	−0.033 (0.210)	0.874	0.092 (0.166)	0.580	(X^2(10)=13.677;p=0.188)	0.957	0.936	0.079 (0.000 to 0.173)	0.106
Weight									
Weight	−0.744 (3.572)	0.835	−1.309 (2.088)	0.531	(X^2(11)=53.501;p<0.001)	0.934	0.910	0.234 (0.173 to 0.299)	0.030
Eating behaviour									
Emotional eating	**0.415 (0.260)**	**0.110**	**−0.727 (0.253)**	**0.004**	**(X^2(11)=22.659;p=0.020)**	**0.887**	**0.846**	**0.166 (0.064 to 0.263)**	**0.123**
Cognitive restraint	0.189 (0.210)	0.369	−0.198 (0.182)	0.279	(X^2(10)=42.102; p<0.001)	0.881	0.822	0.213 (0.149 to 0.281)	0.074
Uncontrolled eating	**0.106 (0.228)**	**0.641**	**−0.376 (0.186)**	**0.044**	**(X^2(11)=16.928;p=0.110)**	**0.935**	**0.912**	**0.127 (0.000 to 0.241)**	**0.072**
Physical activity									
Total physical activity (METs.min.week)	942.521 (1538.217)	0.540	−685.647 (1170.023)	0.558	(X^2(13)=29.031; p=0.006)	0.833	0.808	0.284 (0.144 to 0.423)	0.256
Vigorous physical activity (METs.min/week)	416.358 (327.754)	0.204	−1020.358 (2395.318)	0.670	(X^2(10)=35.848; p<0.001)	0.844	0.765	0.304 (0.241 to 0.369)	0.329
Moderate physical activity (METs.min/week)	480.804 (1146.004)	0.675	−528.559 (1345.585)	0.694	(X^2(13)=10.948; p=0.615)	1.000	1.000	0.000 (0.000 to 0.309)	0.223
Walking (METs.min/week)	297.740 (1494.976)	0.842	−1299.466 (3972.829)	0.744	(X^2(10)=16.824; p=0.078)	0.831	0.988	0.232 (0.000 to 0.419)	0.226
Sedentary behaviour (h/week/weekend)	**1.090 (5.586)**	**0.845**	**−11.560 (6.194)**	**0.062**	**(X^2(10)=10.627; p=0.387)**	**0.993**	**0.989**	**0.034 (0.000 to 0.152)**	**0.079**
HBM - Health beliefs									
Perceived susceptibility	0.071 (0.216)	0.744	0.104 (0.263)	0.694	(X^2(11)=11.484; p=0.404)	0.991	0.988	0.031 (0.000 to 0.160)	0.079

(*Continued*)

Table 5. Continued.

Outcome measures	Intercept (SE)	*p*-value	Slope (SE)	*p*-value	Goodness of fit X^2(df)	CFI	TLI	RMSEA (95%CI)[*1]	SRMR[*1]
Perceived severity	**0.323 (0.196)**	**0.099**	**−0.089 (0.050)**	**0.074**	**(X^2(13)=19.709; *p* =0.103)**	**0.920**	**0.908**	**0.123 (0.000 to 0.226)**	**0.112**
Perceived barriers	**−0.128 (0.234)**	**0.584**	**−0.469 (0.191)**	**0.014**	**(X^2(10)=10.931; *p* =0.363)**	**0.850**	**0.795**	**0.251 (0.144 to 0.362)**	**0.120**
Perceived benefits	**0.487 (0.217)**	**0.025**	**−0.470 (0.258)**	**0.069**	**(X^2(10)=10.267; *p* =0.417)**	**0.998**	**0.997**	**0.025 (0.000 to 0.166)**	**0.102**
Cues to action	−0.210 (0.146)	0.150	−0.065 (0.220)	0.775	(X^2(10)=10.820; *p* = 0.372)	0.994	0.991	0.042 (0.000 to 0.168)	0.072
HAPA - Behavioural change determinants									
Risk perception	0.285 (0.167)	0.088	−0.054 (0.041)	0.189	(X^2(13)=16.738; *p* = 0.212)	0.933	0.923	0.089 (0.000 to 0.199)	0.184
Action self-efficacy	**−0.211 (0.204)**	**0.300**	**0.547 (0.207)**	**0.008**	**(X^2(12)=25.160; *p* =00146)**	**0.830**	**0.788**	**0.205 (0.089 to 0.318)**	**0.187**
Outcome expectancies	0.337 (0.141)	0.017	−0.004 (0.058)	0.941	(X^2(14)=18.329; *p* = 0.192)	0.922	0.916	0.096 (0.000 to 0.205)	0.120
Action planning	**0.045 (0.228)**	**0.844**	**0.302 (0.159)**	**0.057**	**(X^2(11)=14.195; *p* =0.222)**	**0.938**	**0.915**	**0.075 (0.000 to 0.174)**	**0.121**
Coping planning	0.066 (0.281)	0.815	0.253 (0.179)	0.159	(X^2(11)=14.192; *p* = 0.223)	0.926	0.899	0.086 (0.000 to 0.200)	0.113
Maintenance self-efficacy	**−0.421 (0.234)**	**0.073**	**0.462 (0.243)**	**0.057**	**(X^2(11)=22.188; *p* =0.023)**	**0.889**	**0.849**	**0.133 (0.000 to 0.213)**	**0.082**
Intention	**−0.069 (0.248)**	**0.779**	**0.635 (0.203)**	**0.002**	**(X^2(11)=11.176; *p* =0.404)**	**0.997**	**0.996**	**0.020 (0.000 to 0.165)**	**0.061**
Recovery self-efficacy	**0.111 (0.233)**	**0.633**	**0.738 (0.262)**	**0.005**	**(X^2(10)=7.047; *p* =0.721)**	**1.000**	**1.000**	**0.000 (0.000 to 0.129)**	**0.081**
Action control	**0.224 (02442)**	**0.739**	**0.870 (0.226)**	**0.001**	**(X^2(11)=22.700; *p* =0.019)**	**0.820**	**0.755**	**0.174 (0.017 to 0.276)**	**0.105**
Self-esteem									
Self-esteem	**−0.309 (1.592)**	**0.846**	**1.662 (0.906)**	**0.067**	**(X^2(11)=15.834; *p* =0.147)**	**0.967**	**0.955**	**0.099 (0.000 to 0.200)**	**0.082**

Legend: IG (Intervention group); CG (Control group); HBM (Health Belief Model); HAPA (Health Action Process Approach).
[*1]The RMSEA and SRMR values tend to be overestimated for models with few degrees of freedom, as is the case with these LGM.
The values in bold indicate that there are significant effects on the group's trajectories.

behaviour. A marginally significant decrease in this behaviour was identified in the IG compared to the CG ($B = -11.560$, $SE = 6.194$, $p = 0.062$) between T0-T1, with an effect size of −0.39.

Concerning the HBM, the intercept values reflected a higher baseline value of *perceived benefits* in the IG ($B = 0.487$, $SE = 0.217$, $p = 0.025$), and a marginally significant value concerning *perceived severity* ($B = 0.323$, $SE = 0.196$, $p = 0.099$). Regarding intervention effects, marginally significant decreases were observed in the latent growth rate of the IG compared to the CG over time (T0-T4) in *perceived severity* ($B = -0.089$, $SE = 0.050$, $p = 0.074$) and *perceived benefits* ($B = -0.470$, $SE = 0.258$, $p = 0.069$), and a significant decrease in *perceived barriers* ($B = -0.469$, $SE = 0.191$, $p = 0.014$). The effect size was −0.52, −0.61, and −0.76, respectively. No significant treatment effects were found in *perceived susceptibility* and *cues to action* (see Table 5). Regarding the HAPA model, the IG presented significantly higher baseline values of *outcome expectancies* ($B = 0.337$, $SE = 0.141$, $p = 0.017$), marginally higher *risk perception* ($B = 0.285$, $SE = 0.167$, $p = 0.088$), and marginally lower *maintenance self-efficacy* compared to the CG ($B = -0.421$, $SE = 0.234$, $p = 0.073$). Differences in intervention effectiveness between groups were found from T0-T4 related to *intention* ($B = 0.635$, $SE = 0.203$, $p = 0.002$), and marginally significant results regarding *maintenance self-efficacy* ($B = 0.462$, $SE = 0.243$, $p = 0.057$). This indicates an increase in the growth rate of the average of these determinants of behavioural change, with an effect size of 0.59 and 0.72, respectively. Between T0-T2, the IG demonstrated an increase in the average of *action self-efficacy* ($B = 0.547$, $SE = 0.207$, $p = 0.008$), *recovery self-efficacy* ($B = 0.738$, $SE = 0.262$, $p = 0.005$), and *action control* ($B = 0.739$, $SE = 0.226$, $p = 0.001$). The effect size was 0.75, 0.51, and 0.73, respectively. Between T0-T1, the IG showed a marginally significant increase in *action planning* ($B = 0.302$, $SE = 0.159$, $p = 0.057$), with an effect size of 0.57. No significant treatment effects were found in *risk perception*, *outcome expectancies*, and *coping planning* (Table 5). The IG demonstrated an increase in self-esteem levels throughout all assessment moments compared to the CG ($B = 1.662$, $SE = 0.906$, $p = 0.067$), with an effect size of 0.37.

4. Discussion

The ME-WEL e-Health cognitive-behavioural intervention for postmenopausal women with overweight/obesity was delivered in group sessions. It aimed to enhance (i) the frequency of cognitive-behavioural weight management strategies and (ii) subjective well-being. Secondary aims included (i) weight loss, (ii) reduced dysfunctional eating behaviours' frequency, (iii) increased physical activity, enhanced (iv) psychological determinants of weight management, (v) weight-related beliefs, and (vi) improved self-esteem. Intraindividual and interindividual LGMs revealed significant intervention effects on specific outcomes.

4.1. Intervention effects (interindividual)

4.1.1. Primary outcomes

The IG showed significant increases in employing strategies such as *regulation: rule setting* and *energy compensation* (T0-T4), as well as *goal setting*, *planning content*, and

support: motivational (T0-T2). A recent trial explored the associations between OxFAB strategies and weight loss after three months and one year, identifying *goal setting*, *regulation: rule setting*, and *self-monitoring* as the most commonly used domains; and planning associated with eating behaviour positively influenced weight loss over one year (Henry et al., 2023). These authors mainly focused their 12-week intervention on dietary habits, distributing participants into two groups: one addressing techniques such as goal setting, feedback, encouragement, and problem-solving, while the other received a leaflet focusing on reducing energy intake and increasing expenditure, with the first group losing more weight. All these concepts were covered in our intervention. Enhancements in *energy compensation* were particularly beneficial, enabling women to manage dietary slip-ups without overly restrictive diets (associated with poorer weight management outcomes; Marshall et al., 2024). Techniques such as credible information sharing, goal setting, and health consequences information, similar to those employed in our intervention, led to higher fruit and vegetable consumption associated with less physical activity on the same day (that is, *energy compensation*) in the IG (Nigg et al., 2021).

Another observation is that three strategies showed significant effects only between T0-T2. Henry et al. (2023) found that over three months (with adults aged around 50), none of the strategies used were associated with weight loss, but after one year, participants who utilized *goal setting* lost more weight than those using them less frequently. Effective strategies may vary over time and among individuals, with potential shifts between them (Henry et al., 2023). Burke et al. (2015) observed a decline in exercise goal adherence from 70% initially to around 65% by the intervention's end. Similar to our study, the authors employed techniques such as *goal setting* - although individual goals were not conducted during group sessions, differently than in our intervention, which focused on tailored goals, shared in session among participants - and written diaries (in our study, the Logbook). Katterman et al. (2014) emphasized the role of regular group support in initiating and maintaining behaviour change during intervention. These findings underscore the need for intensified strategy emphasis and/or a higher extended intervention duration (at least, more than 12 months; Burke et al., 2015). Differently from our findings, Atten et al. (2018) did not find significant effects of *goal setting* on healthy eating among an older population (>65 years), suggesting that *goal setting* could be more suitable for younger samples, as been emphasized in our results.

All other strategies did not show significant growth in the IG, namely, *imitation: modeling*, *impulse management: acceptance*, *impulse management: awareness of motives*, *regulation: allowances*, *regulation: restrictions*, *restraint*, *scheduling of diet and activity*, *self-monitoring*, *stimulus control*, and *support: help from others*. Research suggests gender and age discrepancy in strategy utilization, with women employing more strategies than men, and older individuals using fewer strategies (particularly in *impulse management: distraction,* and *support: professional*, for example), compared to younger individuals (Henry et al., 2023). Middle-aged women revealed a low frequency of weight management strategies utilization (Leitão et al., 2023a). In our study, all strategies demonstrated low average frequency at T0, with this trend persisting for most of the promoted strategies. Singh et al. (2023) prospective-observational study indicates a decline in weight management strategies over 12 months, particularly among

women. Also, postmenopausal women with overweight/obesity face challenges in implementing certain strategies (particularly those related to *impulse management and information seeking*), possibly due to stressful life events, interpersonal environment, or the lack of quick results (Leitão et al., 2024b). Atten and collaborators (2018) suggest that the intervention's focus may impact outcomes; our study emphasized *planning*, *rule setting*, and *goal setting*, as they were addressed within the OxFAB and the BCTs, and further enhanced with the support of the HAPA model, specifically *action planning* and *coping planning*. Interestingly, despite promoting *self-monitoring* throughout the Logbook, there was no growth observed, aligning with Burke et al.'s (2015) exercises and outcomes. Henry et al. (2023) revealed that the number of weight management strategies employed did not correlate with weight loss, suggesting that it is not the number but the type of strategies tailored to particular groups that are critical. Moreover, several factors, including group dynamics, interpersonal and intrapersonal change process, therapist and participant characteristics, and contextual influences, can impact outcomes (Borek et al., 2019). The CG showed increasing in *information seeking* over time (T0-T4), potentially influenced by initial motivation to participate in a weight management program. In the IG, facilitated scientific content sharing and information exchange (e.g. through the *Whatsapp group*) may have reduced the need for such behaviours.

In the IG, *satisfaction with life* and *positive affect* increased between T0-T2. Group support appears to play a role, supported by RCT findings on subjective well-being (Solanes et al., 2021), highlighting effective exercises such as (i) writing about positive experiences (encouraged in our intervention through weekly Logbook entries - e.g. documenting the benefits acquired after implementing behavioural changes), (ii) solution-focused life coaching groups (reflected in collaborative problem-solving within our study - e.g. mutual assistance in planning physical exercise), and envisioning a successful future self (conducted in our first session - women were prompted to imagine their future selves three months ahead, having implemented behavioural changes). Highlighting the prevalence of high subjective well-being among individuals is important, especially when intervening in this field, as their impact is usually more significant among those with average or lower levels (Solanes et al., 2021), typical among older women (Zaninotto & Steptoe, 2019). Despite starting with above-average *satisfaction with life* and *positive affect*, and low *negative affect*, our study showed significant improvements in the two first variables. Similarly, Czepczor-Bernat et al. (2021) found no differences in *negative affect* over time between groups on emotional regulation, eating behaviour, and body image among premenopausal women.

4.1.2. Secondary outcomes

The IG exhibited significant reductions in *emotional eating* and *uncontrolled eating* over time (T0-T4), initially higher at baseline. Similar findings were found in a study involving premenopausal women, suggesting that strategies for managing emotional situations, such as shifting attention to other activities or accepting attitudes towards emerging feelings (Czepczor-Bernat et al., 2021) can lead to these improvements. Our study incorporated similar strategies and additional ones, such as *planning content* (e.g. avoiding tempting foods in the house), which likely contributed to these results. Additionally, emotional literacy/regulation, covered in our intervention and other

studies (Czepczor-Bernat et al., 2021; Sharifi et al., 2017), may have played a role. Furthermore, group support proved influential in addressing emotional eating but requires further validation (Smith et al., 2023). No significant differences were found concerning *cognitive restraint*, consistent with prior research on Portuguese middle-aged women, suggesting that other variables, such as increased perceived control, could be associated with changes in this behaviour (Pimenta et al., 2012); however, this variable was not assessed in our study.

Some physical activity dimensions showed sufferable model fits, possibly due to incomplete responses to *vigorous* and *moderate activity* items, resulting in insufficient data. To ensure more robust results, it is recommended to use the IPAQ-short version in larger samples, which has demonstrated moderate to acceptable validity in measuring these activities in adults over 60 years, who may engage in unstructured high-intensity physical activities and under-report their *moderate* and *vigorous activity* levels (Cleland et al., 2018). Although significant mobility impairments were an exclusion criterion in this study, middle-aged women with obesity may face physical limitations or other difficulties (e.g. extreme fatigue due to excess body fat; Kim & Kang, 2021), not fully considered here. Furthermore, older adults may struggle with certain questions (e.g. quantifying physical activity intensity; Cleland et al., 2018), impacting self-reported versus objective physical activity measurements (Prince et al., 2008). The absence of accelerometers in our study (used in other studies; Cleland et al., 2018; Prince et al., 2008) could have affected accuracy. Nevertheless, the IG reduced *sedentary behaviour* (T0-T1), possibly attributed to higher outcome expectancies at T0 compared to the CG, aligning with findings from Poppe et al. (2019). Environmental interventions (modifying home/workplace layouts to reduce sedentary time) have proven more effective than behavioural ones (based on theory-driven approaches influencing behavioural determinants to promote physical activity), although both may show sustained effects for up to 6 months (Blackburn et al., 2020). Our cognitive-behavioural intervention emphasizes environmental modifications through strategies like *planning content* (e.g. taking stairs instead of elevators). Additionally, while our intervention shared information about physical activity benefits and obesity severity, similar to a study with middle-aged women with obesity that increased *total physical activity* (Kim & Kang, 2021), our findings were not significant between groups (only in intraindividual analysis). In a study by Nigg et al. (2021) on *energy compensation*, participants reduced physical activity levels over the intervention, suggesting a compensatory effect of healthy eating. While *energy compensation* increased over time in our study, it remains unclear if this affected eating or physical activity behaviours, as this strategy encompassed both.

Regarding the HBM, the IG exhibited a decrease in *perceived severity*, *benefits*, and *barriers* across assessments (T0-T4). Previous interventions also showed decreased *perceived barriers* post-intervention, alongside increased *perceived severity* and *benefits* (Kim & Kang, 2021; Sharifi et al., 2017). Our study employed information sharing and group discussions covering all HBM themes, similar to these interventions (Sharifi et al., 2017). Also, we addressed weight management barriers using the problem-solving [BCT] technique. Notably, the IG started with significantly higher *perceived severity* and *benefits* than the CG, which persisted post-evaluations, contrasting with other RCTs that reported no pre-intervention differences (Faghih et al., 2024; Sharifi et al.,

2017; Tazangi et al., 2022). Varying intervention durations (e.g. Kim & Kang's study [2020] spanned 16 weeks), could have impacted outcomes

In the HAPA model, the IG showed increased *intention*, *maintenance self-efficacy* (T0-T4), *action self-efficacy*, *recovery self-efficacy*, *action control* (T0-T2), and *action planning* (T0-T1). Previous studies promoting physical activity employed techniques like verbal persuasion, individual behaviour planning, and coping strategies to address potential barriers, similar to our study. Keller et al. (2016) reported increased *planning* and *self-efficacy*, emphasizing the need for longer follow-up periods (beyond three months), a limitation in our study with only 3- and 6-month follow-ups. Kim and Kang (2021) and Sharifi et al. (2017) also found heightened *self-efficacy* post-intervention, contrasting with Burke et al.'s (2015) findings of no significant changes. Long-term weight management is challenging, with individuals facing setbacks and interruptions in weight control behaviours (Fleig et al., 2013; Stubbs et al., 2019). The authors recommended booster sessions to maintain intervention effects over time, especially considering their impact on determinants such as planning, self-efficacy, satisfaction, and physical activity levels. As employed in our study, strategies like social support, goal setting, stimulus control, relapse prevention, or problem-solving appear crucial for long-term success (Stubbs et al., 2019). Extending interventions may be beneficial, as the U.S. Preventive Services Task Force (U.S. Department of Health and Human Services, 2019) suggests that most behavioural interventions targeting dietary and physical activity changes typically span one to two years, with a minimum of 12 sessions. No significant treatment effects were found in *risk perception*, *outcome expectancies*, and *coping planning*. Poppe et al. (2019) conducted two identical RCTs with different groups (one with adults aged ≥50 years and another with individuals diagnosed with type 2 diabetes mellitus). They found no intervention effects on *outcome expectancies*, *risk perception*, and *action planning* in the first group, and on *outcome expectancies, coping planning*, and *intention* in the second group. In our study, baseline values for *risk perception* and *outcome expectancies* were significantly higher in the IG, consistent with Poppe et al.'s (2019) findings regarding *outcome expectancies*. Concerning *coping planning,* the authors suggested that the group may not have been fully prepared to benefit from coping planning, although content to address this determinant was focused in a session in our study. Pfeffer and Strobach (2019) suggested that *coping planning* was mediated by *intention*, with stronger *intentions* for physical activity leading to weaker effects in *coping planning*. We also found differences in *intention* without any increase in *coping planning*.

The IG experienced an increase in self-esteem levels, aligning with recent findings indicating positive effects of interventions on self-esteem in adults, particularly cognitive-behavioural ones (Niveau et al., 2021). They emphasize the pivotal role of group dynamics (e.g. promoting inclusion and social acceptance), alongside psychoeducation and strategies such as *positive emotions*, *satisfaction with life*, and *self-efficacy* - elements addressed in our intervention.

4.1.3. Intervention effects (intraindividual) in weight and walking

The intraindividual analysis shows additional results, specifically regarding total physical activity, walking, and weight changes. The IG achieved an average weight loss of approximately 4 kg over time, consistent with other intervention programs where the

average weight loss is 3 kg at 12 months (Baer et al., 2020). However, in the interindividual analysis, statistical significance was not found, possibly due to the small sample size that may compromise the statistical power of the LGM models (Marôco, 2021). Furthermore, longer assessment periods might yield significant results, as suggested by Perri et al. (2008); however, Stubbs et al. (2019) report that interventions based on current behaviour change theories typically have relatively small effects on weight outcomes compared to CG. Additionally, Teeriniemi et al. (2018) found weight reduction post-intervention correlated with initial BMI, with weight loss twice as much in individuals with obesity compared to those overweight - over half of our women fell into the overweight category. The total physical activity results showed significant findings in both groups, potentially influenced by the intervention timing coinciding with favorable weather (facilitating outdoor activities) and festivities (Easter - associated with increased food intake) - we can hypothesize that an energy compensation strategy was employed, given the increases observed in both groups. The possibility of social desirability bias affecting the reported findings cannot be excluded. Furthermore, current weight loss attempts were controlled, with an increase from T0 to T4 in the CG, and a decrease in the IG, which could be influenced by the intervention sessions always focusing on weight management rather than weight loss. The walking dimension increased in IG, where weekly walking challenges were promoted (intensified to three times per week by the 6th session). Group dynamics may have further motivated this increase.

Finally, it is worth emphasizing that the dropout rate did not significantly influence the study's results, with only one participant from the IG **and one from the CG dropped out after T1.** Factors that may have contributed to this low dropout rate can include the ME-WEL intervention's procedures (e.g. sharing credible information, motivational challenges; Lindh-Åstrand et al., 2015), the eHealth format's convenience (e.g. women did not need to travel), and the involvement of an experienced psychologist who established a therapeutic alliance likely fostered participant commitment and adherence. Additionally, the group format proved to be a significant facilitator throughout the program. The vouchers and the possibility for CG participants to access the intervention at the end of the entire process may also have served as incentives for the low dropout rate in the CG**.** Lastly, moderate-to-high effect sizes in our study are promising, as previous interventions showed smaller effect sizes on women's weight management and quality of life (Virtanen et al., 2021) and subjective well-being (Solanes et al., 2021).

4.1.4. Limitations and strengths

Limitations of this study include the small sample size, a common issue in several RCTs (Solanes et al., 2021). Despite initially recruiting around 200 women, strict exclusion criteria resulted in the loss of nearly half the sample. Nevertheless, these criteria were necessary to prevent certain participant characteristics (e.g. musculoskeletal diseases hindering walking) from affecting results. Additionally, only four €50 vouchers were available to enhance adherence and mitigate possible dropouts, potentially insufficient especially for initial adherence. Objective measures like abdominal circumference or biomedical data (e.g. percentage of fat mass) were not assessed, but BMI remains suitable for assessing weight loss interventions in postmenopausal women

(Ghachem et al., 2021). Furthermore, self-reported height and weight are valid for BMI calculation in middle-aged women (Ng et al., 2011). Another limitation could arise from the mixed BMI spectrum among women (overweight and obesity), as they may be at different levels (e.g. perceived susceptibility beliefs). However, evidence suggests intervention groups can accommodate varied BMIs (Katterman et al., 2014). The use of hormone replacement therapy was not taken into account, which may influence **t**he menopause process and its associated symptoms (Opoku et al., 2023), representing another limitation of this study. Some results discussed were marginally significant; while common in intervention studies (e.g. Silberman et al., 2020), these should be interpreted with caution. Despite homogeneity in sociodemographic, health, and lifestyle characteristics between groups, certain sample characteristics (e.g. predominantly professionally active with higher educational qualifications) might influence findings. Additionally, the limited follow-up durations at three and six months may have affected later outcomes, as already mentioned.

The study's strengths include the intervention's effectiveness across several measures, especially within an at-risk population. The incorporation of two theoretical models supporting the ME-WEL intervention, the inclusion of three groups (two IGs and one CG), and the implementation of well-defined BCTs in weekly content enhances replicability in other samples.

5. Conclusion

The ME-WEL intervention demonstrated effectiveness as a brief cognitive-behavioural intervention for postmenopausal women, yielding significant impact across various health determinants for up to 6 months post-intervention. However, replicating this intervention in a different context, with larger samples, is essential to validate its efficacy. Furthermore, increasing the number of intervention sessions and including maintenance sessions (e.g. once a month) appear to be important for achieving more sustained results over time.

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Author contribution statement

We declare that all authors contributed to the study titled 'Menopause and Weight Loss (ME-WEL) Randomised Controlled Trial: An e-health Cognitive-Behavioural Group Intervention for Weight Management in Postmenopausal Women' and have reviewed and approved the final version.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The data that support the findings of this study are available from the corresponding author, ML, upon reasonable request.

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