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Two-Year Follow-Up of an Interdisciplinary Cognitive-Behavioral Intervention Program for Obese Adults

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ABSTRACT. Intervention programs for treating adiposity which focus on dietary change and physical exercise often do not lead to the desired long-term reduction in weight. This article reports on the effectiveness of M.O.B.I.L.I.S., a standardized theory-driven intervention program. Participants are taught cognitive-behavioral strategies of goal setting, action planning, barrier management, and self-monitoring. Persons with obesity ($N = 316$) responded to a public advertisement to participate in the intervention program (IG) or comparison group (CG quasi-experimental design). Assessments were conducted at four time points, with the last assessment being conducted two years after baseline. At the 24-month follow-up, the IG showed weight loss of 5.57%, whereas the CG lost 1.12% of their weight (t1–t4, $p < .01$). The results yielded significant interaction terms (group × time), indicating that the intervention had a substantial effect on food choice and level of physical exercise ($p < .01$). The IG showed significantly enhanced self-efficacy, stronger goal intentions, and more detailed implementation intentions than the CG at follow-ups. The intervention program has the potential to evoke enduring changes in the cognitions we hypothesized to be responsible for inducing obese adults to begin and continue regular exercise and healthy eating behavior, resulting in substantial weight loss.

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Introduction

WEIGHT LOSS AND STABILIZATION involves changing old habits to develop new behavioral patterns to achieve a lifestyle characterized by physical exercise and a healthy diet. However, intervention programs for treating adiposity that focus on dietary change and physical exercise often do not lead to the desired long-term reduction in weight and thus to an improved state of health (Douketis et al., 2005; Perri & Corsica, 2002; Stevens, Truesdale, McClain, & Cai, 2006). Most participants in such programs lose approximately 10% of their initial body weight within six months (National Institutes of Health, 1998). However, long-term evaluation of one-year follow-up programs shows weight loss of at least 10% of initial weight only for a fifth of the participants in a program (Wing & Phelan, 2005). Jakicic and colleagues (Jakicic, Marcus, Lang, & Janney, 2008) report weight loss of at least 10% at 24 months for approximately 30% of participants, but only when they reach high levels of physical exercise (275 min/week). In Germany, it is estimated that only 25% of participants in weight-loss programs succeed in maintaining a weight loss of at least 5% at a three-year follow-up (Westenhöfer, 2005).

In an overview of 23 interventions, Sharma (2007) reports that only two were conducted by trained personnel and that the majority of them lacked a standardized behavioral basis. Moreover, most of the interventions were based on theoretical considerations which were almost exclusively concerned with the influence of motivation (Franz et al., 2007). Even people who are motivated to adopt a healthy and active lifestyle are often not capable of actually accomplishing this. They require help making and implementing concrete plans (so-called implementation plans; Gollwitzer, 1999) and shielding them against confounding factors in daily life.

Our program M.O.B.I.L.I.S. (Multizentrisch organisierte bewegungsorientierte Lebensstiländerung in Selbstverantwortung = Multicenter Self-Directed Lifestyle Change) is a standardized and theory-driven interdisciplinary training program for adipose adults (Berg, Berg, Frey, König, & Predel, 2008; Göhner & Fuchs, 2006; Vogeser, König, Predel, Parhofer, & Berg, 2007). In addition to an exercise program and dietary advice, the program offers participants medical supervision and comprehensive psychological support by skilled trainers. The psychological support is based on the theoretical concept of the MoVo (motivation volition) process model (Fuchs, Göhner, & Seelig, 2011; Göhner, Seelig, & Fuchs, 2009) and serves both to motivate the participants and, most importantly, to help them reach the targets they set for themselves and implement their plans. The MoVo process model integrates central elements of social cognition research

with a strong focus on motivational aspects (Conner, & Norman, 2005; Rutter & Quine, 2002) as well as central elements of action control theories (de Ridder & de Wit, 2006), which emphasize the volitional (self-regulatory) side of behavioral control (Baumeister & Vohs, 2004). According to the MoVo process model, engaging in physical exercise and maintaining a healthy diet requires positive outcome expectations, high self-efficacy, strong goal intentions, detailed implementation intentions, good volitional intention shielding, and positive outcome experiences (Fuchs et al., 2011; Göhner et al., 2009). The goal of our study is to assess the effectiveness of the M.O.B.I.L.I.S. program. Within the context of a quasi-experimental design, the procedure enables a comparison of the cognitive-behavioral and behavioral variables as well as the weight of two groups at four successive measurement points. The paper will present data collected at a 2-year follow-up for the first time.

Methods and Procedures

Research Hypotheses

At 6, 12, and 24 months after the end of the M.O.B.I.L.I.S. program, participants who underwent the intervention (intervention group, IG) will show (a) higher self-efficacy beliefs, stronger goal intentions, and more elaborated implementation intentions; (b) will show a substantially higher level of regular physical exercise and choose healthier food; and (c) are expected to lose substantially more weight and reduce their BMI than persons who did not participate in the intervention program (comparison group, CG). According to the Deutsche Adipositas Gesellschaft (German Obesity Society; 2007), expectations with regard to the amount of weight loss are as follows: At 12 months, a minimum of 50% of the participants are expected to lose at least 5% of their weight, not less than 20% of the participants are expected to lose at least 10% of their weight.

Participants

The target sample included obese people (>18 years, BMI 30–40kg/m^2) who responded to public advertisements in the national press. For the IG, 2350 people responded between August 2005 and May 2006 to the public advertisement to participate in the M.O.B.I.L.I.S. program. Of them, 1411 (60%) were eligible to participate in the program; $n = 403$ (29%) fulfilled all inclusion criteria and were willing to participate in one of the M.O.B.I.L.I.S. groups; $n = 18$ persons of the IG (4.8%) discontinued the program within the first half year ($n = 6$: illness or injury, $n = 1$: dissatisfaction with the program, $n = 4$: excessive strain, vocational, or private changes, $n = 7$: unknown reasons). The remaining $n = 385$ persons of the IG participated in the entire program. For the CG, 285 people responded to the public advertisement to participate in a questionnaire study exactly one year later; $n = 213$ (75%) of them fulfilled all inclusion criteria and were willing to

participate in the study. Six persons dropped out ($n = 1$: change of address, $n = 5$: no longer willing to participate) of the CG, leading to the starting sample of $n = 207$. In addition to the general criteria of age and BMI, the members of the IG had to fulfill the following inclusion criteria: possession of at least one obesity-related risk factor, symptom-free physical power of at least 1 watt per kg of weight, and sufficient motor skills. The exclusion criteria for the IG and the CG included generally accepted contraindications for physical stress, type 1 diabetes, liver, and kidney damage with an indication of protein restriction, psychiatric illnesses and eating disorders, intake of anorexigenic drugs, and the condition after a stomach stapling operation or a malignant tumor disease with a subsequent illness-free interval of less than five years. An additional exclusion criterion for the CG was participation in a systematic behavioral change program.

Sample Flow and Dropout

In the IG, $n = 373$ of the participants returned the first questionnaire (97% of the starting sample), $n = 327$ (85%) of the participants returned the second questionnaire, $n = 315$ (82%) returned the third questionnaire, and $n = 191$ (50%) returned the fourth questionnaire. Data is available for all measurement points for $n = 190$ participants. In the CG, $n = 194$ of the participants returned the first questionnaire (94% of the starting sample of the CG), $n = 166$ (80%) returned the questionnaire for t2, $n = 157$ (76%) returned the questionnaire for t3, and $n = 139$ (67%) returned the questionnaire for t4. A total of $n = 126$ participants of the CG sent back all four questionnaires. The analyses reported in this paper are based on the *longitudinal sample* ($N = 316$) of the IG ($n = 190$) and the CG ($n = 126$).

Sample Description

All participants of the IG took part in the training program, whereas participants of the CG did not undergo any weight reduction program. Participants of both groups took part in the resulting data analysis of their own free will and signed a declaration of consent. They did not receive remuneration for success or participation in the study. The socio-demographic description of the two groups at the first measurement point is presented in Table 1.

Study Design and Procedure

The program was carried out with the consent of the ethics commission of the Faculty of Medicine at the Freiburg University Medical Center. All members of the IG completed the standardized M.O.B.I.L.I.S. program; the members of the CG did not take part in the program and did not receive an alternative program. Data on all participants were collected at four measurement points: t1 was two weeks before the first M.O.B.I.L.I.S. group session (IG) and exactly one year later (CG); t2, t3, and t4 were 6, 12, and 24 months after t1, respectively. All questionnaires were

TABLE 1. Socio-demographic Description of the Sample ($N = 316$)

	Total sample	Intervention group	Comparison group	t	Chi^2	df	p
Female/male	77.5%/22.5%	78.9%/1.1%	75.4%/24.6%		.55	1	.46
Age MW (*SD*), range	50.6 (10.8), 18–75	48.9 (10.9), 18–69	53.2 (10.0), 32–75	3.49		13	<.01
Body Mass Index MW (*SD*), range	34.7 (3.1), 29.5–40.5	35.2 (2.9), 29.5–40.5	34.1 (3.2), 29.5–40.5	−3.19		314	<.01
Vocation							
Manual laborer	2.5%	3.2%	1.6%		27.43	6	<.01
Civil servant	3.8%	1.1%	7.9%				
Currently unemployed	3.5%	2.6%	4.8%				
White-collar worker	48.7%	55.8%	38.1%				
Self-employed	8.5%	6.3%	11.9%				
Other	25.0%	22.0%	34.1%				
Missing	6.6%	1.6%	1.6%				

sent to the participants' home addresses and included a self-addressed stamped envelope.

Intervention

The one-year program M.O.B.I.L.I.S. consists of four components: medical examinations, an exercise program, dietary advice, and group sessions (see Table 2). There is no period of inpatient treatment, no formula diets or weight-loss medications are included.

Based on the MoVo process model, the MoVo group sessions consist of motivational as well as volitional strategies of behavior modification (Fuchs et al., 2011; cf. Milne, Orbell & Sheeran, 2002). Motivational strategies aim at the creation of strong and self-concordant goal intentions. They encompass the following approaches: (a) clarification of personal health objectives ("goal setting"; Locke & Latham, 1990); (b) contemplation of different actions to achieve these health objectives ("decisional balance sheet"; Miller & Rollnick, 2002); (c) formation of strong goal intentions ("decision-making approach"; Holtgrave, Tinsley, & Kay, 1995); and (d) a check on the self-concordance of these goal intentions ("self-generated goals"; Gollwitzer & Sheeran, 2006; Sheldon, 2002). The volitional strategies targeted implementation skills and action control abilities and encompassed the following approaches: (a) generation of implementation intentions ("when-where-and-how plans"; Gollwitzer, 1999; Prestwich, Lawton, & Conner, 2003); (b) anticipation of personal barriers ("perceived internal and external barriers"; Sniehotta, Scholz, & Schwarzer, 2005); (c) development of

TABLE 2. M.O.B.I.L.I.S. Program Structure

Phase I: Weeks 1–7	Phase II: Weeks 8–24	Phase III: Weeks 25–54
Initial medical examination	Intermediate medical examination	Final medical examination
7 exercise units, 1x/week	27 exercise units, 2x/week	—
1 session of dietary practice		2 question & answer sessions on diet
6 group sessions, 1x/week: 1x introduction 1x physical activity recommendations 2x dietary facts and recommendations 3x MoVo group meeting	4 group sessions, every 2–3 weeks: 1x dietary facts and recommendations 3x MoVo group meeting	6 group sessions, every 3–5 weeks: 6x MoVo group meeting

counter-strategies ("barrier management"; Conn, Hafdahl, Brown & Brown, 2008; and, lastly, (d) self-monitoring of the new behavior ("behavioral protocols"; Aittasalo, Miilunpalo, Kukkonen-Harhula, & Parsanen, 2006).

Measures

The questionnaires for all four measurement points included psychological variables from the MoVo process model, differentiated into the areas of exercise and diet (self-efficacy, strength of goal intention, implementation intentions), and behavioral variables (level of physical exercise, diet with regard to healthy food). Participants completed a self-report on their current weight at each measurement. The first questionnaire asked for demographic variables.

Self-efficacy refers to people's belief in their capability to perform a given behavior successfully (Bandura, 1986). In accordance to Schwarzer and colleagues (Luszczynska & Schwarzer, 2003; Schwarzer & Renner, 2000) we assessed three different areas of self-efficacy: belief in being able to begin with regular physical exercise/a healthy diet, belief in being able to maintain regular physical exercise/a healthy diet over an extended time period, and belief in being able to resume regular physical exercise/a healthy diet after an interruption (e.g., due to illness). Each area of self-efficacy was measured with one item; the scores for the three physical exercise items were combined to form one mean value on the variable "self-efficacy/exercise"; the scores for the three healthy diet items were combined to form one mean value on the variable "self-efficacy/diet." The response format was a six-point Likert scale ranging from 0 = "I do not feel capable at all" to 5 = "I feel 100% capable." The descriptive statistics for the variable "*self-efficacy/exercise*" at t1 were: $M = 4.08$; $SE = 0.06$; $SD = 1.06$; median = 4.33; skewness = -1.38; excess = 1.63; the descriptive statistics for the variable "*self-efficacy/diet*" at t1 were: $M = 4.02$; $SE = 0.05$; $SD = .94$; median = 4.00; skewness = $-.94$; excess = .55.

Strength of goal intention was assessed with one item for each behavior: "How strong is your intention to exercise regularly/to maintain a healthy diet within the next weeks and months?" The response format was a 6-point Likert scale ranging from 0 ("I don't have the intention to do so at all") to 5 ("I have a strong intention to do so"). The descriptive statistics for the variable "*strength of goal intention/exercise*" at t1 were: $M = 3.93$; $SE = 0.07$; $SD = 1.20$; median = 4.00; skewness = -1.17; excess = 1.01; the descriptive statistics for the variable "*strength of goal intention/diet*" at t1 were: $M = 4.41$; $SE = 0.04$; $SD = .76$; median = 5.00; skewness = -1.06; excess = .29.

Implementation intentions (Gollwitzer, 1999). The participants were asked whether they already knew which physical exercise they would engage in and which healthy diet they would maintain in the next weeks and months. Participants who answered "yes" were asked to indicate the physical exercise (e.g., Nordic walking) and diet (e.g., reduced fat) they were planning. They were also given

the opportunity to name a second exercise/diet. Subsequently, the participants were asked whether they already knew when and where they would perform each of the exercises, how they would get there, and how often and with whom they would perform it. For each diet, the participants were only asked whether they already knew when they would perform it. Pre-studies revealed that the participants had difficulties providing an account of their diet; we will discuss this matter in the discussion section. A score for the implementation intentions was formed by adding the number of positive answers for each scale (including naming the exercise/diet plus planning details). The descriptive statistics for the summary variable "*implementation intentions/exercise*" at t1 were: $M = 7.11$; $SE = 0.26$; $SD = 4.73$; median = 8.00; skewness = −.07; excess = −1.02; range = 0 to 15; the descriptive statistics for the summary variable "*implementation intentions/diet*" at t1 were: $M = 2.76$; $SE = 0.14$; $SD = 2.46$; median = 2.00; skewness = .16; excess = −1.59; range = 0 to 6.

Physical Exercise. We used the short version of the Freiburg Questionnaire on Physical Exercise (FFKA; Frey, Berg, Grathwohl, & Keul, 1999) for the study. The total exercise time is the sum of the time participants spent on each activity (e.g., daily activities like walking/bicycle riding, garden work, and stair climbing as well as sporting activities and dancing). All time measurements are converted to hours per week. The descriptive statistics for the variable "*physical exercise*" at t1 were: $M = 1.57$; $SE = 0.12$; $SD = 2.13$; median = .93; skewness = 2.46; excess = 9.12.

Diet. We used the questionnaire "Healthy Eating Habits" (Seelig & Fuchs, 2006) to collect data on the quality of the participants' diets. The participants were asked which foods they would select if they were given the choice. The foods included in the questionnaire were organized into 13 contrasting pairs of high-fat and low-fat foods as well as high-cholesterol and low-cholesterol foods chosen as representative for each class of food. The participants received one point for each low-fat or low-cholesterol food they selected and a possible additional two points for sufficient fluid intake (>2l per day) as well as for low-energy drinks (max. score 15 points). One point was deducted for each high-fat or high-cholesterol food (max. score −13 points). Items left blank were given zero points. These values were combined to form a total score. The descriptive statistics for the variable "*diet*" at t1 were: $M = 5.11$; $SE = 0.25$; $SD = 4.44$; median = 5.00; skewness = −.15; excess = −.37; range −13 to 15.

Weight. The Participants were asked to self-report their weight in kg at each of the measurement points. Due to the self-report we assume that data are systematically biased (Dhaliwal, Howat, Bejoy, & Welborn, 2010). For the IG, we had the possibility to collect objective data and analyse correlations between objective and subjective measures at measurements t1, t2, and t3. The correlations between subjective and objective values are high (self-report IG: mean/standard deviation t1: 101.47/12.81, t2: 94.28/13.14, t3: 94.28/14.15; objective measure IG: mean/standard deviation t1: 102.11/13.00, t2: 94.97/13.33, t3: 95.15/14.05;

correlation t1: $r = .98^{**}$; t2: $r = .99^{**}$; t3: $r = .96^{**}$). We still see this approach as a limitation of the study and will discuss this later.

Body Mass Index. The participants' dimensions were taken at the first measurement point. The participants were asked to indicate their weight in kg and height in cm at each of the measurement points.

Results

Statistical Analyses

We performed statistical analyses using the SPSS statistical software, version 18.0, with the type I error rate fixed at $p < .05$ (two-tailed). We conducted analyses of covariance for repeated measures (t1 to t4) with the given psychological variables (self-efficacy, strength of goal intention, and implementation intentions), behavioral variables (exercise and diet), and BMI as dependent variables. IG vs. CG was the independent variable, and sex and age were covariates. Exact results are reported in Table 3. The *intervention effect* is indicated by the interaction term "group by time" for the time interval t1 to t3 (end of the M.O.B.I.L.I.S. intervention). The *maintenance of the intervention effect* is indicated by the main effect of the "group" variable at t3 and t4. Figures 1 display the results in graph form. A *comparison of the IG and CG* with a t-test for independent random samples at t1 revealed significant differences for all but one variable (implementation intentions/diet). We therefore cross checked the influence of the starting level for each variable at each measurement using t1 as covariate in an ANCOVA.

Change of Body Mass Index

The results yielded a significant intervention effect as well as a significant maintenance effect (Table 3, Figure 1). The members of the IG were able to reduce

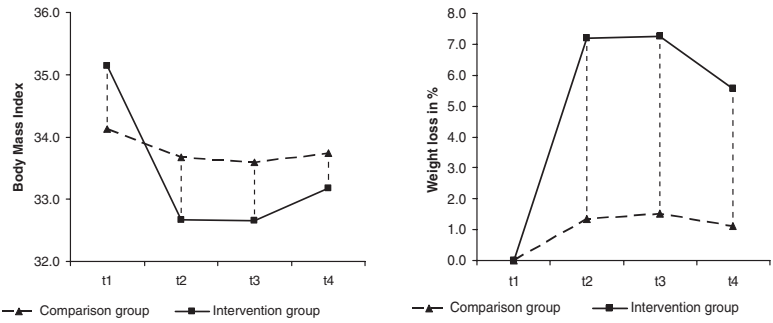

FIGURE 1. Means of BMI and means of percentage weight loss (%) for the intervention and comparison group. Exact results are reported in Table 3.

TABLE 3. Means (*M*) and Standard Deviations (*SD*) for Intervention and Comparison Group: Interaction and Group Effects.

	Analyses for all four measurements				Intervention effect (interaction group × time at t1, t2 and t3)				Maintenance of intervention effect (main effect group at t3 and t4)			
Variable	M t1 (*SD*)	M t2 (*SD*)	M t3 (*SD*)	M t4 (*SD*)	*F* (group by time)	*df*	*p*	eta^2	*F* (group)	*df*	*p*	eta^2
Self-efficacy/exercise												
CG	3.70 (1.26)	3.66 (1.29)	3.67 (1.28)	3.70 (1.34)								
IG	4.34 (.78)	4.44 (.72)	4.48 (.76)	4.34 (.93)	.85	2, 305	.43	.016	35.97	1, 306	<.01	.11
Test of significance[a]	**	**	**	**								
Self-efficacy/diet												
CG	3.82 (.97)	3.83 (1.15)	3.89 (1.09)	3.79 (1.25)								
IG	4.15 (.86)	4.20 (.85)	4.19 (.91)	3.96 (1.02)	.23	1, 304	.80	.01	.34	1, 289	.56	.01
Test of significance[a]	**	**	**	n.s.								
Strength of goal Intention/exercise												
CG	3.47 (1.40)	3.38 (1.34)	3.37 (1.52)	3.35 (1.50)								
IG	4.24 (.90)	4.47 (.77)	4.51 (.73)	4.16 (1.14)	3.65	2, 294	.03	.02	54.05	1, 301	<.01	.15
Test of significance	**	**	**	**								
Strength of goal Intention/diet												
CG	4.23 (.89)	4.37 (.83)	4.25 (.97)	4.11(1.03)								
IG	4.50 (.66)	4.33 (.81)	4.28 (.83)	4.15 (.96)	6.10	2, 288	<.01	.04	.92	1, 295	.34	.01
Test of significance	**	n.s.	n.s.	n.s.								
Implementation Intentions/exercise												
CG	8.25 (4.24)	7.60 (4.41)	7.14 (4.64)	6.74 (4.00)								
IG	6.38 (4.89)	10.85 (3.34)	9.96 (5.31)	10.04 (4.30)	44.87	2, 310	<. 01	.22	38.47	1, 311	<.01	.11
Test of significance	**	**	**	**								

Implementation Intentions/diet												
CG	2.96 (2.33)	2.82 (2.23)	2.64 (2.31)	2.58 (2.30)								
IG	2.62 (2.53)	3.97 (2.26)	4.16 (2.26)	3.28 (2.49)	18.31	2, 310	<. 01	.12	26.56	1, 311	<.01	.08
Test of significance	n.s.	**	**	*								
Physical exercise												
CG	2.11 (2.71)	2.10 (2.52)	2.24 (3.11)	1.75 (2.34)								
IG	1.26 (1.64)	4.45 (3.33)	3.23 (2.54)	3.23 (2.96)	42.00	2, 270	<.01	.24	16.37	1, 228	<.01	.07
Test of significance	**	**	**	**								
Diet												
CG	5.89 (4.64)	7.04 (4.37)	7.15 (4.28)	6.74 (4.21)								
IG	4.58 (4.24)	9.77 (3.28)	10.42 (3.47)	9.71 (3.56)	52.43	2, 310	<.01	.25	58.85	1, 311	<.01	.16
Test of significance	**	**	**	**								
Weight												
CG	97.54 (13.56)	96.32 (13.97)	95.97 (14.30)	96.34 (14.99)								
IG	101.47 (12.81)	94.28 (13.14)	94.28 (14.15)	95.89 (14.58)	49.46	2, 307	<.01	.24	1.77	1, 305	.19	.01
Test of significance	**	n.s.	n.s.	n.s.								
BMI												
CG	34.13 (3.26)	33.67 (3.48)	33.59 (3.56)	33.74(4.02)								
IG	35.15 (2.86)	32.66 (3.33)	32.66 (3.67)	33.18 (3.69)	46.65	2, 307	<.01	.24	6.04	1, 305	.02	.02
Test of significance	**	**	**	n.s.								

Note. CG = control group; IG = intervention group.

[a]Between groups at the given time point.

* $p < .05$. ** $p < .01$.

TABLE 4. Percentage Weight Loss in Four Categories at 12- and 24-Months

	Intervention group		Comparison group	
12-month follow-up				
Weight loss > 10%	29.5% ($n = 56$)	54.8% (104)	7.1% ($n = 9$)	21.4% (27)
Weight loss 5–10%	25.3% ($n = 48$)		14.3% ($n = 18$)	
Weight loss 0–5%	35.3% ($n = 67$)		45.2% ($n = 57$)	
Weight gain	10.0% ($n = 19$)		32.5% ($n = 41$)	
24-month follow-up				
Weight loss > 10%	22.6% ($n = 43$)	47.9% (91)	5.6% ($n = 48$)	22.3% (28)
Weight loss 5–10%	25.3% ($n = 48$)		16.7% ($n = 21$)	
Weight loss 0–5%	30.5% ($n = 57$)		38.9% ($n = 51$)	
Weight gain	16.3% ($n = 32$)		37.3% ($n = 48$)	

their BMI significantly more than the CG and even keep these values until the end of the program (t3). Results revealed significant group differences at t2 and t3 even if the group difference at t1 is included as covariate (separate ANCOVAs at t2 and t3 with t1 as covariate: $p < .01$). Looking at the percentage of weight loss ("net" weight loss), the picture becomes clearer: Whereas the CG showed weight loss between 1.35% (t1–t2), 1.52% (t1–t3), and 1.12% (t1–t4), the IG lost 7.20% (t1–t2), 7.25% (t1–t3), and 5.57% (t1–t4). The differences were significant at all follow-up measurement points ($p < .01$). Table 4 displays the percentage of weight loss for each group in categories (at least 5% and 10% weight loss).

Behavioral Change—Physical Exercise

An analysis of covariance yielded a significant group-by-time interaction term, indicating that the M.O.B.I.L.I.S. intervention had a substantial effect on level of physical exercise (Table 3, Figure 2). The IG improved from 1.26h/week to 4.45h/week of physical exercise between the first and second measurement points. Results revealed significant group differences at t2, t3, and t4 even if the group difference at t1 is included as covariate (separate ANCOVAs at t2, t3, and t4 with t1 as covariate: $p < .01$). It should be–3 noted that regular participation in the M.O.B.I.L.I.S. sport program alone brings an additional 2h of exercise per week, but even after subtracting these two hours from the total, the IG still managed 2.45h/week of self-organized physical exercise. In the further course of the study, the extent of physical exercise stagnated at slightly over 2h/week in the CG, while the levels of physical exercise reported by the IG remained constant at 3.23h/week at t3 (end of program) and at t4 (24 months after baseline).

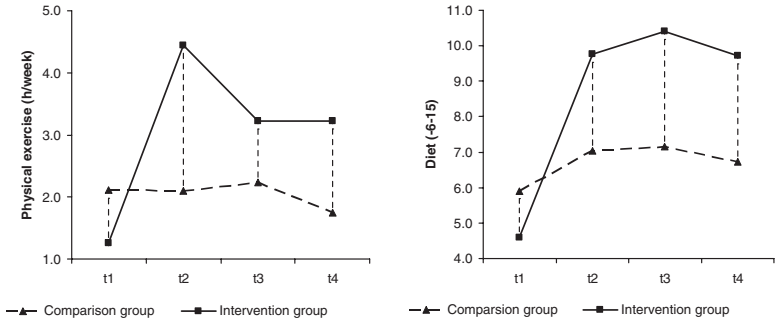

FIGURE 2. Means of physical exercise and means of diet. Exact results are reported in Table 3.

Behavior Change—Diet

The results yielded a significant group-by-time interaction term, indicating that the M.O.B.I.L.I.S. intervention had a significant effect on food choice (Table 3, Figure 2). The IG reported significantly higher values than the CG at t2, t3, and t4. This indicates that the participants of the IG selected the more healthy foods in approximately 10 of the 13 possible cases, while the CG only selected them approximately 7 times on average. Again, results revealed significant group differences at t2, t3, and t4 even if the group difference at t1 is included as covariate (separate ANCOVAs at t2, t3, and t4 with t1 as covariate: $p < .01$).

Change of Psychological Variables

The results revealed no interaction effect for the variable *self-efficacy/exercise* (Table 3, Figure 3). The IG started at t1 with significantly higher values than the CG and maintained this high level over all three follow-up measurements, leading to significant differences between the groups before the program (t1), during the program (t2), at the end of the program (t3), and one year after the end of the program (t4). Results revealed significant group differences at t2, t3, and t4 even if the group difference at t1 is included as covariate (separate ANCOVAs at t2, t3, and t4 with t1 as covariate: $p < .01$). Results for the variable *self-efficacy/diet* revealed again significantly higher levels of self-efficacy in the IG at t1 (although the level of self-efficacy/diet values was lower than that of self-efficacy/exercise) than the CG. In this variable, the ANCOVA with t1 as covariate led to non-significant main effects group (ANCOVA at t2, t3, and t4 with t1 as covariate: $p = .10$; $p = .21$, $p = .70$, respectively). Analyses of variance revealed a significant interaction effect for the variable *strength of goal intention/exercise*. Although the IG started with significantly stronger goal intentions with regard to exercise at t1 than the CG (significant group differences at t2, t3, and t4 even if the group difference

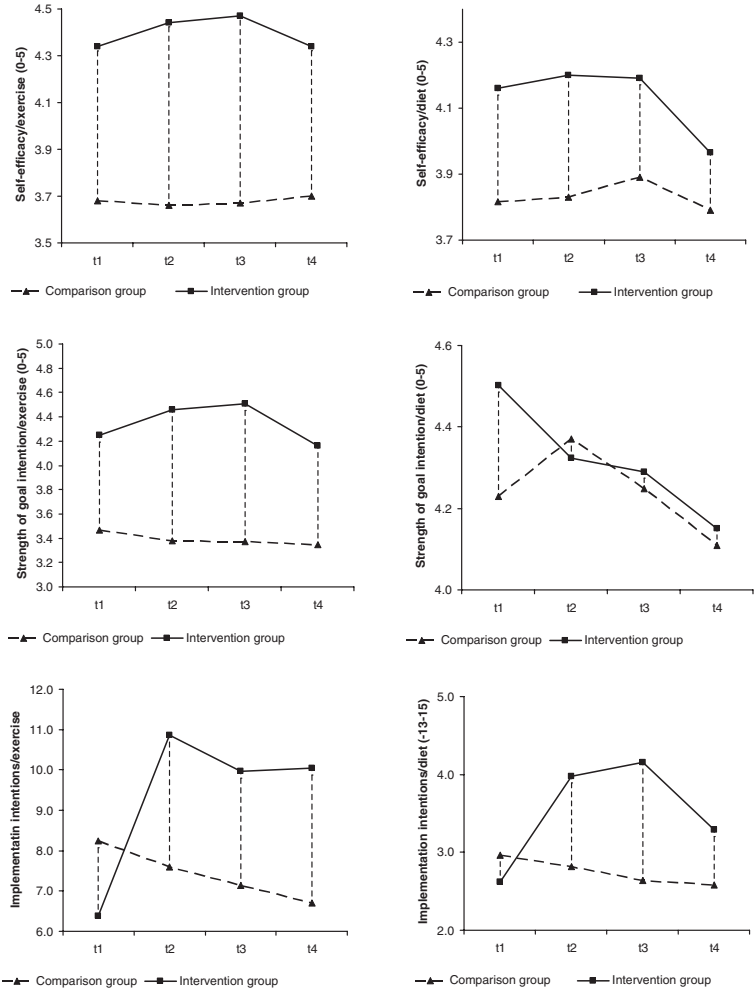

FIGURE 3. Means of self-efficacy/physical exercise and diet; means of strength of goal intention/exercise and diet; means of implementation intentions/exercise and means of diet. Exact results are reported in Table 3.

at t1 is included as covariate: $p < .01$), the participants of the IG were still able to increase their values over the next two measurements (t2, t3), whereas the CG showed a slight decrease over all three follow-up measurements. However, the participants of the IG did not succeed in maintaining their strong intentions

one year after the end of the program, where values dropped back under the initial levels (t4). Due to the low intention levels of the CG, the differences were still significant at t4. The results for the variable *strength of goal intention/diet* revealed a significant intervention effect. However, at t1, the values of the IG were significantly higher than those of the CG, results for ANCOVAs with t1 as covariate revealed non-significant main effects at two of the following measurements (ANCOVA at t2, t3, and t4 with t1 as covariate: $p = .05$; $p = .79$, $p = .25$, resp.). Over the next three measurements, the participants of the IG did not manage to keep their strong intentions and showed a constant decrease; at t2 they were already back at the same level as the CG. Interestingly, both groups still showed the same high strength of goal intentions/diet as did the participants of the IG with regard to exercise intentions. On the variable *implementation intentions/exercise*, the results again revealed a significant intervention effect. As with almost all of the variables, there was a significant difference at t1, the ANCOVAs at t2, t3, and t4 with t1 as covariate revealed still significant main effects group: $p < .01$. However, in this case the participants of the CG indicated that they had significantly more elaborate plans than the participants of the IG. The values of the IG on this variable increased strongly over the first half of the program and almost stabilized by two years after the program, whereas the values of the CG decreased continuously over all three follow-up measurements (significant group differences at t2, t3, and t4). Again, we observed a significant intervention effect for the variable *implementation intention/diet*. Starting with less elaborate dietary plans at t1 (ANCOVA at t2, t3, and t4 with t1 as covariate: $p < .01$), the IG indicated that they had significantly more detailed plans at t2 and t3, with the IG clearly exceeding the CG (significant group differences at t2 and t3). This significant difference between the groups was maintained over the next 12 months until the last measurement two years after baseline, although in the IG the means decreased slightly over time.

In summary, we were able to confirm most of our research hypotheses: Participants who underwent the M.O.B.I.L.I.S. intervention lost substantially more weight over the time period of one year (duration of the program) than participants who did not receive this intervention. There were no significant differences between the groups two years after baseline. We reached and partly exceeded expectations with regard to net weight loss: 29.5% (12 months) and 22.6% (24 months) of the participants of the IG lost more than 10% of their weight; 54.8% (12 months) and 47.9% (24 months) of the participants of the IG lost more than 5% of their weight. The participants of the IG showed a substantially higher level of regular physical exercise at the 6-, 12-, and 24-month follow-ups and chose healthier food than participants of the CG. Participants who underwent the M.O.B.I.L.I.S. intervention showed enhanced levels of self-efficacy/diet and physical exercise, stronger goal intentions/exercise, more detailed implementation intentions/exercise, and diet at the 6- and 12-month follow-ups (t3) than did persons who did not participate in M.O.B.I.L.I.S. In all but three variables (self-efficacy/diet, strength of goal intention/diet, BMI), the results revealed significant

differences between the groups at 24 months (t4). To cross check the influence of the starting level, we conducted further analyses of covariance with t1 as covariate for each variable at each measurement.

Discussion

The purpose of this study was to evaluate the effects of a theory-based, standardized group intervention program on specific psychological factors which are assumed to induce people to begin and maintain regular physical exercise and improve their eating behavior over a period of two years. In addition, we evaluated the effects of this program on behavior itself (physical exercise and diet) as well as on weight reduction.

The results reported suggest that the intervention was effective in increasing the level of physical exercise and optimizing qualitative food intake in obese patients, leading to a substantial loss of weight and thus reducing their risk of contracting illnesses associated with obesity (Ross et al., 2000; Klein et al., 2004). Two years after baseline (t4), the IG was still physically active 3.23h per week, whereas the CG only reported 1.75h of physical exercise per week ($p < .01$). Likewise, at t4 the members of the IG reported that they chose healthy food significantly more often than those of the CG ($p < .01$). Regarding BMI at t3, the two groups differ significantly ($p < .01$) with the IG showing more weight loss. Two years after baseline this difference is no longer statistically significant due to a weight gain in the IG. Still, the members of the IG lost 5.51% of their weight over the course of two years whereas the CG was only able to lose 1.2%. These results suggest that behavioral changes are based on changes in the underlying psychological factors. Using the MoVo process model as a theoretical framework for the intervention, we looked at the variables self-efficacy, strength of goal intentions, and implementation intentions for physical exercise as well as diet. With regard to the variables strength of goal intention/exercise, strength of goal intention/diet, implementation intentions/exercise, and implementation intentions/diet, the results showed significant intervention effects. Except for strength of goal intention/diet, these intervention effects remained relatively stable over the next 12 months (t3 to t4). Taken together, these findings confirm our research hypothesis that M.O.B.I.L.I.S. has the potential to evoke enduring changes in the cognitions we assumed to be responsible for inducing obese adults to begin and continue regular physical exercise and healthy eating behavior, resulting in substantial weight loss.

We want to highlight several aspects:

a) We see the significant differences at baseline between the groups as a statistical limitation of our study. However, it is understandable that people who sign up for a time-consuming and (for the time being) expensive one-year program will be more motivated than people who respond to

a newspaper advertisement on weight loss. This may be seen in part in the clearly higher values the IG reported on the motivational variables self-efficacy and intentions at t1. At the same time, the members of the IG believed themselves to have less volitional competence, and indeed they engaged less often in physical exercise and chose healthy foods less often than the members of the CG at baseline (with lower baseline values, some of them significant, for implementation intentions concerning diet and exercise as well as for exercise and diet behavior). This indicates that the members of the IG might have identified their weakness in carrying out the behavioral patterns they wished to change and used their high motivation to sign up for a program which promises to increase their volitional competence. This existing lack of volitional competence in the IG at t1 in comparison to the CG is also evident in the higher initial weight of the members of the IG.

b) The strongest intervention effects were found for the variables implementation intentions/exercise ($eta^2 = .22$) and implementation intentions/diet ($eta^2 = .12$), reflecting the fact that a considerable amount of time throughout the program was devoted to identifying, carrying out, and evaluating personal implementation intentions. The participants succeeded in maintaining this intervention effect for both variables for a year after the end of the program ($eta^2 = .11$, $eta^2 = .08$, resp.); thus, the intervention may have evoked a lasting change on the level of implementation intentions, a factor that is known to be of high relevance for establishing a physically active lifestyle and a healthy diet (Lippke, Ziegelmann, & Schwarzer, 2004). This positive influence of volitional competence really does lead to a change in behavior in the long term. However, the expected stabilization of weight is no longer discernible at the two-year follow-up. According to Jakicic et al. (2008), 4.35 h of exercise a week is necessary for a long-term stabilization of weight; an amount which the participants in the M.O.B.I.L.I.S. program did not achieve. Moreover, the variable implementation intentions/diet "only" took account of the quality of the participants' diets. Although quantitative aspects of diet do play a role in the program, the current operationalization does not control whether the participants have changed the amount of food intake. Thus, it might be that despite their high volitional competence, success in improving the quality of their diets, and increased physical exercise the participants are still unable to maintain their weight because the quantity of their food intake is too high and the extent of their physical exercise too low. Nevertheless, even a full two years after the program, the participants still come close to fulfilling the criteria of the German Obesity Society.

c) With the exception of the variables implementation intentions/exercise and exercise behavior, we see a descriptive and/or statistical decrease in all values from t3 to t4 in the IG, suggesting that after the end of the program

motivational as well as volitional competence – especially in the area of diet – needs some kind of booster session. The decision not to offer such booster sessions is based on the idea that participants have to assume responsible for them at some point in the program, at the very latest by the end of the program.

d) Although our field study included self-selection at several points, the external validity of the findings should still be high. Obese people from all over Germany had the possibility to enter the program if they fulfilled the inclusion criteria. The content as well as the educational procedures of M.O.B.I.L.I.S. are standardized (Göhner & Fuchs, 2006), allowing the effects to be reproduced.

Limitations

Baseline differences between groups at t1 make it difficult to interpret the differences between groups at follow-up measurements. Therefore, we elaborated how values develop using t1 as the covariate. We cannot be certain that the effects are a clear result of our intervention as our design did not allow for a randomization procedure; factors other than the treatment could account for the differences between the groups. The two groups were selected according to the same procedures and criteria; however, the CG began the study one year after the IG. We do not know which parts of the intervention accounted for how much of its effectiveness. The program consisted of a broad combination of intervention techniques, and one person might profit from a single intervention whereas another person might need a mixture of interventions or might profit from the group dynamics, which were not the topic of our investigation. We had no possibility to use objective measures in the analyses for the CG. We cannot completely rule out the possibility that patients may have indicated a lower weight and overestimated their height in order to meet the expectations of the trainer (Dhaliwal et al., 2010). This is also the case for the psychological as well as the behavioral variables. However, in the general literature the differences are estimated to be relatively small (what is supported by our high correlations within the IG between subjective and objective measures), and are accepted for the recruitment procedure for nationwide programs as well as to keep costs low (Bolton-Smith, Woodward, Tunstall-Pedoe, & Morrison, 2000). Last, the M.O.B.I.L.I.S. program is a costly and complex program.

Future Directions

Over a period of one year the participants of the IG gained sufficient volitional competence in the areas of diet and exercise to achieve a significant reduction in their weight in comparison to the CG. Two years after the end of the program, their volitional competence and changed behavior remained constant, but they gained back some of the weight they had lost during the program. It appears that their physical exercise and diet are no longer sufficient at this point to continue losing weight. This raises the question as to whether the recommendations on

the appropriate amount of exercise and healthy diet made during the program should be modified. It should also be taken into consideration whether it would be helpful to offer booster sessions by telephone or mail. And last: despite fulfilling the requirements of the German Obesity Society, 16.3% of the participants in M.O.B.I.L.I.S. gain weight a year after the end of the program. Why? Which subgroups profit most from this program, and which do not profit at all?

AUTHOR NOTES

Wiebke Göhner is a professor at the Catholic University of Applied Sciences. Her current research interests are volitional aspects of behavior change in theory and practice, with regard to different target groups (persons with back pain or obesity, or after orthopedic rehabilitation). **Martina Schlatterer** is a clinical psychologist and currently a research assistant at the University of Freiburg. **Dr. Harald Seelig** is a sport psychologist and employed as an associate professor at the University of Freiburg. **Dr. Ingrid Frey** is a research assistant at the University Hospital in Freiburg. **Andreas Berg** (M.A.) is the executive director of the intervention program MOBILIS e.V. **Reinhard Fuchs** is a professor of sport psychology at the University of Freiburg.

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