

## ORIGINAL ARTICLE

# Exercise Based Lifestyle Intervention in Obese Adults

Results of the Intervention Study M.O.B.I.L.I.S.

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## SUMMARY

**Introduction:** Obesity is one of the greatest public health challenges of the 21st century. A combination of diet and exercise interventions have been shown to deliver stable weight reduction. M.O.B.I.L.I.S. is an interdisciplinary lifestyle modification program, aimed at lasting modification of exercise levels and diet with a view to an energy balanced lifestyle and healthy living skills.

**Methods:** Lifestyle changes are to be achieved via a 12-month exercise based intervention. This standardized training program is to be followed up at predetermined time intervals in a planned sample size of 4000 to 5000 obese adults (BMI 30 to 40 kg/m<sup>2</sup>). As target variables body weight, body mass index, and waist circumference were defined.

**Results:** One year results are now available for 32 groups and 454 obese participants. The results clearly demonstrate that lifestyle changes in obese individuals are possible and lead to an average weight reduction of 6.4 kg at 12 months.

**Discussion:** M.O.B.I.L.I.S. constitutes an effective, economic, and non-pharmacological therapy option for obese adults.

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**Key words:** obesity, lifestyle intervention, physical activity, weight loss, M.O.B.I.L.I.S.

Within the last few years in industrial countries, it has become clear that storing energy in the form of fat can be a major risk to health. Most people are overfed and do not have to be physically active. As a consequence, the energy balance for most people is positive and they are at risk of becoming overweight. This is why obesity – defined by the WHO as a body mass index of greater than 30 kg/m<sup>2</sup> – is now one of the most frequent health problems in Germany. According to information from the Robert Koch Institute, 20% of the overall population and almost 30% of the population between 50 and 60 years of age, exhibit obesity requiring treatment (1).

There is a correlation between obesity and several chronic diseases (2). Even life expectation – the most reliable endpoint – is significantly impaired by obesity. Thus, pathological overweight decreases life expectancy at the mean adult age by about six years (3). This is similar to the effect of smoking. In contrast to other chronic diseases, obesity is mostly only treated once secondary conditions have developed.

With this background, Freiburg University Hospital and the German Sports Academy (Deutsche Sporthochschule) in Cologne have developed M.O.B.I.L.I.S., a multicenter exercise-orientated initiative for independent lifestyle modification. This is an interdisciplinary training program for the therapy of obesity and the associated risk factors. With the help of regionally based M.O.B.I.L.I.S. teams, the program has now been established throughout Germany and offers an approach to improve the population's healthy living skills. The following article presents the initial results with this instrument to treat adult obesity. The full evaluation of the program has not yet been performed.

## Methods

For effective weight loss, it is absolutely essential to combine measures for changes in nutrition, physical activity, and behavior (4, 5, 6). In keeping with this principle, M.O.B.I.L.I.S. presents individual ways to live a health conscious life. The objective is to achieve a lifestyle with energy balance and improved healthy living skills.

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**TABLE 1**

**Personal and anthropometric data of the participants at the start of the training program**

	Total group	Subjects completing course	Drop-outs
Number (n)	517	454	63
Age (years)	48.6 ± 11.09	48.8 ± 11.09	46.9 ± 11.01
Proportion of Women (%)	75.4	75.8	73.0
Weight (kg)	102.5 ± 13.9	101.9 ± 13.7	107.4 ± 14.45*
BMI (kg/m <sup>2</sup> )	35.7 ± 3.02	35.6 ± 3.02	36.6 ± 2.87*
Waist Circumference (cm)	112.5 ± 11.3	112.5 ± 11.2	112.8 ± 11.7

\* The initial weight and initial BMI were significantly greater (p<0.01) for the participants who subsequently dropped out than for those who completed the program.

M.O.B.I.L.I.S. is based on the results and experience of the institutions for sports medicine which initiated it and incorporates strategies from behavioral psychology as an essential and original component (7). The most important factor for successful weight loss is the acceptance of the chosen change in behavior and the compliance this leads to. Specific questions of nutrition and exercise tend to be of secondary importance (7, 8). The four central themes are exercise/sport, psychology/instruction, nutrition, and medicine. These are communicated to the group in 20 theoretical and 35 practical units. There are different phases in a defined program calendar for each group. These are distributed over a period of 12 months: a seven-week starting phase, a 17-week weight reduction phase, and a six-month stabilization phase.

Under the leadership of a sports teacher or sports scientist, the participants meet once or twice a week, by turns outside (whatever the weather) and in a hall, to gain sporting experience within the group. The emphasis is on various types of endurance training, such as power walking or Nordic walking, as well as specific exercises to strengthen the musculature and for coordination and relaxation. With the help of the 50+50 point program (specially developed for M.O.B.I.L.I.S.), the participants learn how to implement the listed activities within their everyday lives. The theme of changes in behavior is discussed with a psychologist or teacher in 10 group meetings. Each meeting concentrates on a special group of themes. The participants are given theoretical information and instructed to solve written or oral problems. The volunteers are also called on to continue with specific tasks in their daily life related to behavioral modification and to document progress.

The nutritional section contains three group meetings, one practical meeting and two question and answer sessions; these are led by a dietary assistant or nutritional scientist. Rather than strict diet plans or

rigid nutritional restrictions, M.O.B.I.L.I.S. emphasizes orientation towards the correct selection of foods. The most important recommendations are low fat, carbohydrate consciousness, and high protein nutrition. Based on the example of the M.O.B.I.L.I.S. pyramid, concrete recommendations are given for diet which supports fitness and their implementation is practiced. The individual components (behavior, exercise, and nutrition) have already been described in detail in previous publications (7, 9).

In accordance with the guidelines of the German Obesity Society (Deutsche Adipositas Gesellschaft, DAG) (10), the objectives of this program are to reduce weight and to improve the risk factors, health behavior, and quality of life. To achieve this, a trained interdisciplinary team supports the participants in the course of a year to prepare personal health concepts and objectives and to integrate these into normal daily life. This team consists of sports scientists and psychologists/teachers with experience of working with groups, as well as certified nutritional scientists and doctors.

A local training group includes both men and women. The group should include between 15 and 18 people. Formation of new groups is announced in good time over the local media, as well as on the M.O.B.I.L.I.S. homepage ([www.mobilis-programm.de](http://www.mobilis-programm.de)). Adults are enrolled with BMI from 30 to 40 kg/m<sup>2</sup> and with a comorbidity associated with obesity, such as hypertension, insulin resistance and/or dyslipoproteinemia. There is no age limit in principle. However, the participants must still be capable of exercise, i.e. asymptomatic performance of at least one Watt per kg body weight and adequate motoric competence. For the exercise practice, they must be capable of taking part in walking sports, such as power walking and Nordic walking.

Exclusion criteria are:

- Contraindications to physical exertion (11) and weight reduction or calorie restriction (10)
- Type 1 diabetes
- Liver and kidney damage with the indication for restricted protein intake
- Psychiatric diseases and eating disorders (bulimia, bulimia nervosa, binge eating disorder)
- Intake of anti-obesity drugs
- Status after malignant disease with freedom from disease of less than five years.

As of 1 January 2008, the total costs per participant are 785 euros for 12 months of group care. As a result of an overall agreement with the Barmer Health Insurance Fund, costs can be reimbursed as a lump sum, in accordance with Article 43 No. 2 of the SGB V [Social Security Code V], with a personal contribution of 100 euros. M.O.B.I.L.I.S. is also open to people insured by other health insurance funds. Thus the conditions have been created which would permit implementation of a program for obesity treatment throughout Germany under standard conditions. M.O.B.I.L.I.S. is administered through a charitable

**TABLE 2a**

**Relative distribution of the participants (n = 517) and their absolute weight changes in the period of intervention for each result class**

	Drop-outs	Participants with weight increase	Participants with poor results (0% – 4.9% weight loss)	Participants with good results (5% – 9.9% weight loss)	Participants with very good results (10% or more weight loss)
Number (n)	63	77	142	118	117
Percentage	12.2	14.9	27.5	22.8	22.6
Difference (kg)	ND*	3.0 ± 2.98	-2.6 ± 1.39	-7.4 ± 1.62	-16.3 ± 5.45

Classification of the results according to relative weight increase, or weight losses of 0% – 4.9%, 5% – 9.9% and 10% or more.

\*ND: no data; no information available on weight changes of drop-outs.

Data given as means ± standard deviation; Differences are the differences from the intervention (after – before)

**TABLE 2b**

**Anthropometric data at the start and after one year's participation for the group completing the program (n = 454)**

	Before	After	Difference	Significance
Weight (kg)	101.9 ± 13.7	95.5 ± 14.8	-6.4 ± 7.45	p < 0.001
BMI (kg/m <sup>2</sup> )	35.6 ± 3.02	33.3 ± 3.82	-2.2 ± 2.57	p < 0.001
Waist Circumference (cm)	112.5 ± 11.2	105.2 ± 12.0	-7.2 ± 8.52	p < 0.001

Data given as means ± standard deviation; Differences are the differences from the intervention (after – before)

society and pursues no commercial interests of any sort. The planning of the program is also independent of the interests of third parties.

The results and changes are followed during the course of the program. This is based on Case Report Forms (CRFs), kept by a doctor, and with defined examination time points (at the start, after six months and after 12 months), as well as with a questionnaire on activity and quality of life (Freiburg Questionnaire on Leisure Time Activity [Freiburger Fragebogen zur Freizeitaktivität]; Questionnaire on State of Health [Fragebogen zum Gesundheitszustand], SF 36, Hogrefe Verlag, Göttingen). The documentation covers not only changes in weight, but also reduction in health risk factors and changes in health behavior (exercise and nutrition) and in the quality of life. The participant's weight and waist circumference are measured by standardized methods in the team doctor's practice. It is possible to take meal replacements as a supportive nutritional measure (10) – such as a clinically tested soy-milk-honey product (12). This was also queried by the team doctor and documented in the CRF. The team manager also documented presence at the training units. In addition, the questionnaires recorded participant satisfaction in the individual phases of the training program, which were then evaluated with the balance score card

system. These data are evaluated soon after collection and support continual adaptation and improvement in the training program.

There are now M.O.B.I.L.I.S. teams at about 100 sites, organized by a central office. Between 13 January 2004 and 31 December 2006, 1412 obese adults started the M.O.B.I.L.I.S. program and 517 have already completed it. Eminent politicians have served as "godfathers" for M.O.B.I.L.I.S. in their home towns or electoral districts and have served as patrons or advocates of the project. This has won high general esteem for the program. Details of the program's organization can be found on the M.O.B.I.L.I.S. homepage ([www.mobilis-programm.de](http://www.mobilis-programm.de)), which is updated daily.

All participants take part freely in the training program and the subsequent data analysis, after giving their written consent. They receive no fees for participation or success. The program is performed with the agreement of the Ethics Committee of the Faculty of Medicine at Freiburg University.

SPSS 13.0 was used for the statistical evaluation. The Wilcoxon test for paired samples was used for the intraindividual comparison between the status before and after intervention. Variance analysis was performed to establish whether there were significant differences between the subgroups with respect to the differences before and after intervention.

**TABLE 3**

**Anthropometric data at the start and after one year of participation for the group who completed the course, split by gender (female n = 344, male n = 110)**

	Before	After	Difference	Significance
<b>Age (years)*</b>				
Female	47.6 ± 10.85	–	–	–
Male	52.5 ± 11.02	–	–	–
<b>Weight (kg)*</b>				
Female	98.3 ± 11.4	91.9 ± 12.5	–6.33 ± 7.53	p < 0.001
Male	113.2 ± 14.1	106.5 ± 15.9	–6.64 ± 7.26	p < 0.001
<b>BMI (kg/m<sup>2</sup>)</b>				
Female	35.7 ± 3.04	33.4 ± 3.86	–2.28 ± 2.66	p < 0.001
Male	35.3 ± 2.95	33.2 ± 3.71	–2.08 ± 2.24	p < 0.001
<b>Waist Circumference (cm)*</b>				
Female	109.8 ± 10.8	102.4 ± 11.1	–7.2 ± 8.98	p < 0.001
Male	120.8 ± 8.3	113.8 ± 10.7	–7.0 ± 6.93	p < 0.001

\* There were significant differences between the two groups (p<0.001) with respect to initial age, absolute weight, and waist circumference. There were no differences in the BMI values and the changes achieved after one year of participation. Data given as means ± standard deviation; Differences are the differences from the intervention (after – before)

**Results**

On 31 October 2006, 32 groups had completed the program of 12 months. Their data were used for the present evaluation. 454 of the 517 registered participants completed the program. Complete paired data from the initial and final examinations are available for these 454 persons. The proportion of the participants who dropped out of the current program came to 12.2% (table 1). Of those who completed the program, 90.7% (n = 412) took part regularly, i.e. in more than 75% of the training units. This means that they fulfilled the condition agreed with Barmer for the reimbursement of their costs.

The data from the 517 participants in the 32 completed groups are summarized in table 1. The mean age of the participants was 49 years; the youngest was 18.3 years old and the oldest 75.4 years old. 390 were women (75.4%) and 127 men (24.6%). The participants reported favorably on their satisfaction with the program.

The description of the results is restricted to changes in weight as primary endpoint and the rate of success in the volunteers who completed the course (table 2). A subgroup analysis includes the effects of the factors gender, age, and initial BMI (tables 3, 4 and 5).

The anthropometric data for those who completed the program and those who dropped out differ with respect to body weight and BMI (table 1). Thus, the dropouts were in the mean 5.5 kg heavier and their BMI was correspondingly greater by one unit.

The results for those who completed the program are given in table 2. At the final examination, the

mean change in absolute weight was –6.4 kg, in BMI –2.2 kg/m<sup>2</sup>, and in waist circumference –7.2 cm. Nevertheless, there were also individuals who exhibited little or no improvement.

The success of the therapy was influenced by the frequency of participation in the group meetings. The weight changes were –2.1 kg more favorable for regular participants, although this trend was not statistically significant (p = 0.08). The initial flexible intake of a replacement meal had a favorable effect on weight loss. 22% of the participants fell back on this form of nutritional therapy (10) during a period of about two months and attained greater weight reduction during the first weeks in this way. This was also reflected at the end of the program, with a difference of 1.8 kg. Thus, the loss of weight without the replacement meals was 6.0 ± 6.85 kg and with them 7.8 ± 8.02 kg (p < 0.05).

The changes in the anthropometric parameters after one year of participation were largely the same for men and for women (table 3). Both genders attained mean decreases in BMI of more than two units, in absolute weight of more than 6 kg and in waist circumference of more than 7 cm. The mean relative weight decrease was 6.4% for women and 5.9% for men.

The success of the program did not depend on age (table 4). In spite of differences in physical performance, comparable results were attained in the three age groups (under 45 years, 45 to 60 years and over 60 years).

The success of the therapy did not depend on initial BMI (table 5). Participants with obesity grade I

**TABLE 4**

**Anthropometric data at the start and after one year of participation for the group completing the program, split by age group (18–44.9 years, 45–59.9 years, 60 years and older).**

Age Group*	n	Age (years)	Performance (Watt/kg)	
18–44.9 years	170	37.2 ± 6.44	1.35 ± 0.29	
45–59.9 years	200	52.2 ± 3.84	1.28 ± 0.27	
60 years and older	84	64.2 ± 3.28	1.15 ± 0.23	
Weight (kg)	Before	After	Difference	Significance
18–44.9 years	104.2 ± 14.9	97.9 ± 15.8	-6.3 ± 7.91	p < 0.001
45–59.9 years	101.0 ± 12.9	94.7 ± 14.6	-6.3 ± 7.59	p < 0.001
60 years and older	99.2 ± 12.5	92.3 ± 12.0	-7.0 ± 6.11	p < 0.001
BMI (kg/m <sup>2</sup> )	Before	After	Difference	Significance
18–44.9 years	36.0 ± 3.01	33.8 ± 3.78	-2.16 ± 2.67	p < 0.001
45–59.9 years	35.4 ± 3.02	33.2 ± 4.10	-2.18 ± 2.65	p < 0.001
60 years and older	35.1 ± 2.95	32.6 ± 3.00	-2.46 ± 2.11	p < 0.001
Waist Circumference (cm)	Before	After	Difference	Significance
18–44.9 years	111.3 ± 10.9	105.1 ± 12.7	-6.19 ± 8.56	p < 0.001
45–59.9 years	112.6 ± 10.8	105.1 ± 12.4	-7.48 ± 7.77	p < 0.001
60 years and older	114.5 ± 12.6	105.6 ± 9.6	-8.46 ± 9.94	p < 0.001

\* As a result of their definition, there are significant differences between the groups with respect to age and physical performance. There are no significant differences with respect to anthropometric parameters and the changes achieved after one year of participation. Data given as means ± standard deviation; Differences are the differences from the intervention (after – before)

(BMI 30 to 34.9) and grade II (BMI 35 to 39.9) gave similar results.

**Discussion**

The experience and the results achieved as yet with the M.O.B.I.L.I.S. program show that obese persons with BMI from 30 to 40 kg/m<sup>2</sup> can successfully lose weight if they regularly participate in an exercise-orientated training program, independently of gender, age, and initial weight. A mean weight reduction of 6.4 kg or 6.3% can be expected during 12 months. Bearing in mind that a spontaneous weight gain of ca. 0.5 kg within 12 months would have been predicted (13), the mean weight loss of 2.6 kg for responder group I (*table 2a: participants with poor results*) must also be regarded as favorable.

This is also supported by comparison with the results from other pharmacological and non-pharmacological studies (14, 15). Thus, non-pharmacological interventions on obese adults normally achieve mean weight reduction of about 3 kg within 12 months (15).

Even though the proportion of women (75%) was, as expected, clearly higher than that of men (25%), the program was accepted by men and successfully completed (16). Thus, the gender distribution did not influence the proportion of dropouts. The proportion of dropouts is almost the same for women (11.8%) and for men (13.4%). There were significant differences (p < 0.001) between men and women with respect to initial age and in absolute

weight and waist circumference (as expected from genderspecific physical differences). However, there were no differences in BMI. It can be assumed for both groups that the mean reduction in waist circumference of 7 cm corresponds to a reduction in visceral fat weight of ca. 2.1 kg (17, 18). This result can therefore be seen as an important reduction in both cardiovascular and metabolic risk.

As no valid measurements for evaluating muscle mass are available for routine medical measurements, no parameters other than BMI and waist circumference were recorded to assess body composition. Thus, we cannot say whether both the fat and muscle mass of the participants were reduced. Nevertheless, the final examination showed that not only the relative performance (Watt/kg), but also the absolute performance (Watt) of the participants was significantly increased (Berg A et al. 2008: in preparation).

It is also possible to lose weight successfully in an exercise-orientated training program at an age of over 60 years. Moreover, these results also provide arguments against the frequent demand for homogenous groups and the necessity of specifically modifying the available training, depending on the participants' age and fitness. Once the hurdle has been jumped to take part in the program, regular and successful participation is possible, even if the initial weight is high. Although the initial phases appear to be more difficult for persons with grade II obesity (BMI 35 to 40 kg/m<sup>2</sup>;



**TABLE 5**

**Anthropometric data at the start and after one year of participation for the group completing the program, split by initial BMI: 30–34.9 kg/m<sup>2</sup> (n = 202), 35–40 kg/m<sup>2</sup> (n = 252)**

	Before	After	Difference	Significance
<b>Age (years)*</b>				
30–34.9 kg/m <sup>2</sup>	50.1 ± 11.0	–	–	–
35–40 kg/m <sup>2</sup>	47.8 ± 11.1	–	–	–
<b>Weight (kg)</b>				
30–34.9 kg/m <sup>2</sup>	94.2 ± 11.0	88.2 ± 11.8	–6.00 ± 6.69	p < 0.001
35–40 kg/m <sup>2</sup>	108.0 ± 11.0	101.3 ± 11.8	–6.72 ± 8.01	β < 0.001
<b>BMI (kg/m<sup>2</sup>)</b>				
30–34.9 kg/m <sup>2</sup>	32.7 ± 1.43	30.7 ± 2.50	–2.07 ± 2.27	p < 0.001
35–40 kg/m <sup>2</sup>	37.9 ± 1.72	35.5 ± 3.28	–2.35 ± 2.78	p < 0.001
<b>Waist Circumference (cm)</b>				
30–34.9 kg/m <sup>2</sup>	107.0 ± 9.6	88.2 ± 11.8	–6.00 ± 6.69	p < 0.001
35–40 kg/m <sup>2</sup>	116.9 ± 10.5	109.5 ± 11.7	–7.24 ± 9.32	p < 0.001

\* As a result of their definition, there are significant differences (p < 0.02) between the groups with respect to absolute and relative weight and waist circumference. There are no significant differences with respect to the changes achieved in body weight, BMI, and waist circumference after one year of participation. Data given as means ± standard deviation; Differences are the differences from the intervention (after – before)

see initial weight of dropouts in *table 1*), it is perfectly possible for them – like persons with grade I obesity – to reduce their body weight by 6.7 kg or 6.2% in the course of one year of participation.

The weight reduction was about 6.5 kg over 12 months for all subclasses and, according to the principle of negative energy balance (objective ca. 400 kcal/day), this indicates that long-term weight reduction can be achieved by the combination of calorie reduction and increased activity. We must wait to see whether these results can be confirmed in the planned final evaluation with 4000 to 5000 participants. It will also be an important objective to improve the predictability of the success of the M.O.B.I.L.I.S. program in dependence on personal characteristics. This seems to be necessary, firstly, to transfer dropouts and non-responders to other modes of intervention which would be more promising for them and, secondly, to optimize the program components and to stabilize the success of the training program.

**Conflict of interest statement**

Professor Aloys Berg has received support for studies from Almased Wellness GmbH, Bienenbüttel; Südzucker AG, Mannheim/Grünstadt; and Roche Diagnostics GmbH, Mannheim. He has also received payment for lectures from Almased Wellness GmbH, Bienenbüttel, and Central Marketing Gesellschaft der deutschen Agrarwirtschaft mbH (CMA), Bonn.

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Dr. Frey, Dr. König PD and Prof. Predel declare that there is no conflict of interest in the sense of the guidelines of the International Committee of Medical Journal Editors.

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