Peer-reviewed | Manuscript received: December 23, 2016 | Revision accepted: March 8, 2017

Edmonton Obesity Staging System (EOSS)

A descriptive analysis of obese patients on the multimodal weight loss program DOC WEIGHT®

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Abstract

The multimodal weight loss program DOC WEIGHT® was developed because of a rising prevalence of obesity in Germany. The objective of the program is to reduce the incidence of overweight and obesity-related diseases in the long term. This study examines the changes which occurred during the one-year program assisted by a classification according to the Edmonton Obesity Staging System (EOSS) as regards related to diseases, metabolic parameters and impairment in quality of life.

To this end, 141 patients were retrospectively classified using the EOSS at the time of the initial examination (t_0) and after completion of the program (t_1) (stage 0: no risk factors to stage 4: end stage related diseases). At t_0 82.3% of patients were assigned to stage 2. At the time of the final examination t_1 most patients were also allocated to stage 2 (n = 112; 79.4%). However, the frequency of stages 2 and 3 decreased in favor of stages 0 and 1. 26 patients were assigned to a stage at least one lower at t_1 compared to t_0. There was an overall average stage improvement of 0.16. Significant improvements were also seen among the majority within each stage in terms of the presence of co-morbidities, medications taken and pathological lab results.

Keywords: obesity, Edmonton Obesity Staging System, health risk, weight loss program, DOC WEIGHT®

Citation:
Hellbardt M, Schwalm SV, Winckler K, Schilling-Massmann B (2017) Edmonton Obesity Staging System (EOSS). A descriptive analysis of obese patients on the Multimodal Weight Loss Program DOC WEIGHT©. Ernahrungs Umschau 64(6): 90–95

This article is available online: DOI: 10.4455/eu.2017.021

Introduction

Obesity is a chronic disease which is accompanied by a reduction in quality of life and an increased risk of morbidity and mortality. It requires a long-term treatment [1]. The prevalence of obesity in Germany has risen significantly in recent decades [2] – a trend seen not only in Germany; the number of obese people is expected to rise to 1.12 billion worldwide by 2030 [3]. BMI, on which the World Health Organization's (WHO) classification of overweight and obesity is based, is regarded as insufficient as the sole indicator in the assessment of the health of obese people. A comprehensive view of physical and psychological health is required to assess the clinical picture and the choice of suitable treatment. The Edmonton Obesity Staging System (EOSS) developed by Sharma and Kushner (2009) also considers the severity of obesity-related health risks, the presence of co-morbidities and reductions in quality of life in addition to the body weight [4]. The superiority of the EOSS in comparison to BMI in relation to mortality has already been shown by the evaluation of the system in comprehensive cohort studies [5, 6].

This study uses the EOSS to examine changes in obesity-related diseases, metabolic parameters and reductions in quality of life among parti-

Stage	Classification criteria [7]	Modified study definition[a]
0	no apparent obesity-related risk factors (normal blood pressure, serum lipids, fasting glucose), no physical symptoms, no psychopathology, no functional limitations or impairment of well-being.	All values studied lie within the normal range.
1	– presence of obesity-related risk factors (borderline hypertension, impaired glucose tolerance, elevated liver enzymes) – mild physical symptoms (e.g. dyspnea during moderate activity, occasional pain, fatigue, etc.) – mild psychopathology – mild functional limitations and/or mild impairment in quality of life	– blood pressure ≥ 130/85 mm Hg – fasting glucose ≥100 und < 125 mg/L – cholesterol ≥ 200 und < 240 mg/dL – HDL cholesterol < 60 mg/dL – LDL cholesterol ≥ 100 und < 155 mg/dL [b] – triglycerides ≥ 150 und < 200 mg/dL
2	– presence of obesity-related chronic diseases (e.g. hypertension, diabetes mellitus type 2, sleep apnea, osteoarthritis, reflux disease, polycystic ovary syndrome, anxiety disorder, etc.) – moderate limitations in everyday activities and/ or moderate impairment in quality of life	– diagnosed hypertension or taking medications to lower blood pressure – blood pressure ≥ 140/90 mm Hg – diabetes mellitus type 2 or taking medications to regulate glucose – fasting glucose ≥ 125 mg/dL – hyperlipidemia or taking lipid reducers – cholesterol ≥ 240 mg/dL – HDL cholesterol < 40 mg/dL – LDL cholesterol ≥ 155 mg/dL [b] – triglycerides ≥ 200 mg/dL – hyperuricemia or uric acid ≥ 7,0 mg/dL[c] – polycystic ovary syndrome – sleep apnea or continuous positive airway pressure (CPAP) therapy – behavioral disorders, affective disorders or taking antidepressants/antipsychotics – relevant orthopedic functional limitations
3	– manifest damage to organs, such as heart attack, heart failure, complications of diabetes mellitus, disabling osteoarthritis – major psychopathology – major functional limitations and/or impairment to quality of life	***criteria from stage 2 plus:*** – ischemic heart disease – glomerular filtration rate < 60 mL/min/1,73 m² [d]
4	– severe disabilities due to chronic obesity-related diseases (potential end stage) – severely debilitating psychopathology, severe functional limitations and/or severe impairment in quality of life	*Patients in this stage do not fulfil the conditions for participation in the program and were therefore not admitted to the program from the outset.*

Tab. 1: **Edmonton Obesity Staging System (EOSS): definition and adaptation for evaluation**
[a] based on the parameters recorded in the DOC WEIGHT® program
[b] according to the European Association for Cardiovascular Prevention & Rehabilitation et al. (2011) [11]
[c] according to Yamanaka et al. (2011) [12]
[d] The glomerular filtration rate was calculated by means of the MDRD formula (Modification of Diet in Renal Disease) [13].
HDL = high density lipoprotein; LDL = low density lipoprotein

cipants on the weight loss program DOC WEIGHT® (Version 1.0).
It also aims to show whether participation in the program corresponds to the EOSS classification criteria for the choice of treatment and whether the EOSS is suitable as a decision-making tool for treatment management through a BMI-independent assessment of comorbidities and a differentiation in the severity of obesity.

Methodology

DOC WEIGHT® Program and EOSS

The interdisciplinary, multimodal and behavioral-therapy-oriented

weight loss program DOC WEIGHT® was developed to achieve a long-term effective reduction in pathological overweight and obesity-related secondary diseases as well as malnutrition and lack of exercise. The program is delivered in interdisciplinary teams, comprising nutrition physicians, nutrition specialists (dietitian, nutritional scientists), psychologists and exercise therapists. Participants attend individual meetings in which they are informed about the changes in eating and drinking habits, changes in behavior and the active moving lifestyle. They should be able to integrate these topics into their everyday life on a lasting basis. The target groups for the one-year program are obese adults with a BMI ≥ 40 kg/m² or ≥ 35 kg/m² with apparent secondary or accompanying obesity-related diseases [7]. These entry criteria correspond to the currently valid indication criteria for a bariatric operation in Germany [8].

However, BMI is insufficient as the sole indicator to assess the efficiency of a bariatric operation [9]. Rather, classification of the severity of obesity according to the EOSS shows that individual treatment can be introduced depending on the risk factor and following classification of the patients in one of the stages in the staging system (stage 0: no risk factors, stage 1: risk factors present, stage 2: pronounced risk, stage 3: significant end organ damage, stage 4: end stage of secondary diseases). Prevention and counselling about lifestyle changes are therefore the focus of treatment in stages 0 and 1. The same applies to stage 2, as part of a basic program of nutritional and behavioral changes and physical training. A bariatric surgery procedure would be indicated for weight reduction in stage 3 and on an individual basis in stage 4, as significant end organ damage and/or chronic secondary diseases are already present in these stages.

Implementation

To assure the quality of the DOC WEIGHT® program, somatic and psychological data on the study participants were acquired using a standardized method by 11 specialist nutrition physicians from the *Bundesverband Deutscher Ernährungsmediziner e. V.* (BDEM). In addition to the initial examination (t_0; n = 218), a final examination was carried out at the end of the program (12 months; t_1; n = 144), as well as a follow-up examination for some patients one year after the end of the program (24 months; t_2; n = 24). Examination t_2 was not included in the analysis due to the low number of participants (n = 24) [10]. Of the data available at t_0 and t_1, only data sets which concerned people whose data had been recorded on both occurrences were included (n = 141). Participating specialists were instructed to record complete scientific data; however, it was apparent that the specialists did not consistently obtain comprehensive data for all parameters. Missing values were not substituted in this analysis.
This analysis retrospectively consulted selected parameters from the recorded data, such as hypertension, diabetes mellitus type 2, dyslipidemia, hyperuricemia, polycystic ovary syndrome (PCOS), sleep apnea, relevant orthopedic functional limitations and psychological illnesses. The parameters included in the analysis are illustrated in ◆ Table 1.

The relevant criteria for classification followed those of Kuk et al. (2011) [6]. Unavailable and additional recorded parameters, which were relevant for classification, were not replaced and/or amended. Stage 0 was defined by the absence of stages 1, 2 and 3.

No criteria for stage 4 were defined owing to contraindications for participation in DOC WEIGHT®. Participation in the program was contraindicated in the following instances:

- insufficient physical ability of person concerned (≤ 1 Watt/kg body weight),
- severe accompanying diseases, which excluded basic or water-based structured group exercise programs (e.g. in joints and/or spinal column or dermatological illnesses with open or chronic wounds),
- manifest acute psychiatric illnesses, such as e.g. untreated depression and psychosis, severe dementia, lack of capacity, substance addiction such as alcohol, drug or medication abuse, untreated binge eating disorder and bulimia,
- lack of motivation,
- forms of obesity which lead to secondary obesity [7].

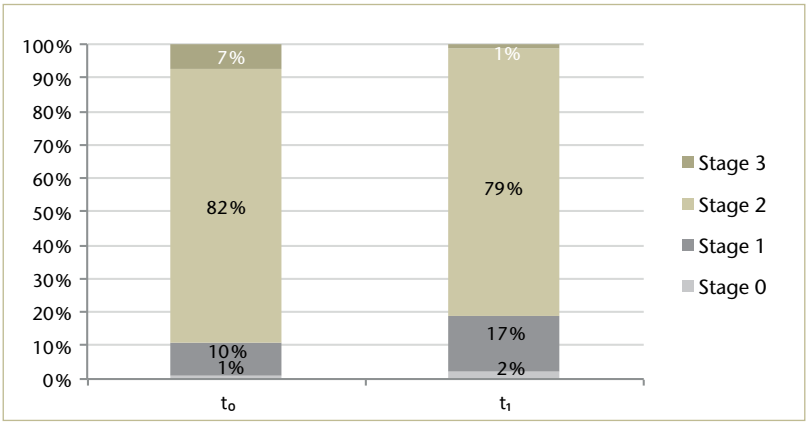

Fig. 1: **Classification of patients in the EOSS at points t_0 and t_1** (n = 141)

The parameter which was assigned the highest level was the decisive factor in the classification of individual participants.

Results

Data from 141 patients (women: n = 88, 62.4%; men: n = 4, 2.8%; lack of data on gender: n = 49) were included in the analysis. The average age of participants at examination t_0 was 43 (standard deviation [SD] = 11.3; range 19–67 years; n = 81). The EOSS classification of patients showed that 82.3% (n = 116) of patients were assigned to stage 2 at examination t_0. This proportion had marginally decreased at the end of the program by 2.9% to 79.4% (n = 112). The number of patients in stage 1 therefore rose from 14 at the initial examination t_0 to 24 at t_1 (◆ Figure 1). Although classification remained unchanged for 111 patients at the final examination (t_1), 26 patients were classified at least one stage lower. The most frequent change was from stage 2 to stage 1 (n = 14). Two patients even improved by two stages in comparison to the initial examination (t_0). Only four patients were classified higher at t_1 than at the initial examination (t_0); of these, three patients moved from stage 1 to stage 2. The average stage value improved overall by 0.16 from 1.96 (SD = 0.45) at t_0 to 1.80 (SD = 0.48) at t_1.

A change from stage 2 to stage 1 indicates the complete disappearance of all diseases detailed in the list of criteria. However, improvements in the condition of the disease, exclusive of a complete cure, were not taken into account. For this reason, the number of comorbidities, medications taken and pathological lab results at both examinations were also included in the analysis. A decrease in comorbidities present within both stage 2 and stage 3 at point t_1 compared to t_0 was appa-

	level 2		level 3	
	t_0; n (%) (n = 116)	**t_1; n (%)** (n = 112)	**t_0; n (%)** (n = 10)	**t_1; n (%)** (n = 2)
hypertension	44 (37.9)	47 (42.0)	8 (80.0)	2 (100.0)
diabetes mellitus type 2	27 (23.3)	30 (26.8)	7 (70.0)	1 (50.0)
dyslipidemia	11 (9.5)	6 (5.4)	1 (10.0)	0 (0.0)
hyperuricemia	22 (19.0)	16 (14.3)	6 (60.0)	1 (50.0)
psychological illnesses	18 (15.5)	20 (17.9)	3 (30.0)	1 (50.0)
PCOS	1 (0.9)	1 (0.9)	0 (0.0)	0 (0.0)
sleep apnea	8 (6.9)	8 (6.9)	1 (10.0)	0 (0.0)
relevant orthopedic functional limitations	25 (21.6)	24 (20.7)	5 (50.0)	1 (50.0)

Tab. 2: **Incidence of different obesity-related diseases at points t_0 and t_1 according to EOSS stage**
PCOS = polycystic ovary syndrome

	t_0		t_1	
	M (n)	**SD**	**M (n)**	**SD**
number of medications taken				
stage 0	0.00 (1)	0.00	0.00 (3)	0.00
stage 1	0.00 (14)	0.00	0.00 (24)	0.00
stage 2	0.91 (115)	1.48	0.98 (111)	1.46
stage 3	2.60 (10)	2.59	3.50 (2)	4.95
lab results outside normal range				
stage 0	0.00 (1)	0.00	0.33 (3)	0.58
stage 1	2.57 (14)	1.34	2.38 (24)	1.01
stage 2	3.98 (109)	1.47	3.68 (105)	1.56
Stufe 3	5.00 (10)	1.15	6.50 (2)	0.71

Tab. 3: **Frequency of medications taken and lab results outside the "normal range" at points t_0 and t_1 according to EOSS Stage**
M = average; SD = standard deviation

	t_0		t_1	
	M (n)	**SD**	**M (n)**	**SD**
weight (in kg)				
stage 0	136.00 (1)	0.00	100.60 (2)	12.64
stage 1	109.14 (14)	14.85	98.85 (23)	17.76
stage 2	118.28 (116)	31.46	113.12 (112)	34.22
stage 3	130.75 (10)	22.68	145.05 (2)	18.03
BMI (in kg/m²)				
stage 0	37.30 (1)	0.00	36.95 (3)	1.89
stage 1	39.51 (14)	6.35	35.49 (23)	6.15
stage 2	42.73 (111)	6.81	41.29 (106)	8.29
stage 3	46.40 (10)	6.10	46.96 (2)	9.92

Tab. 4: **Weight and BMI progression at points t_0 and t_1 according to EOSS stage**
M = average; SD = standard deviation

rent in the clinical pictures for dyslipidemia and hyperuricemia. A reduction in the presence of relevant orthopedic functional limitations was also observed within stage 2. In contrast, the clinical pictures for hypertension, diabetes mellitus type 2 and psychological illnesses revealed a percentage and absolute increase within stage 2 (◆ Table 2).

Data on medications taken was available for 140 patients at both measuring points (t_0 and t_1). Patients in stages 0 and 1 were taking no medications at both examinations. In stage 2, the proportion of medications taken increased between t_0 and t_1 from an average of 0.91 (SD = 1.48; range 0–15; n = 115) to 0.98 (SD = 1.46; range 0–7; n = 111) medications per person. The average number of medications taken in stage 3 also increased by 0.9 to 3.5 (SD = 4.95; range 0–7; n = 2) drugs taken per person (◆ Table 3). Lab results outside the normal range were analyzed for a total of 134 patients. These improved in stages 1 and 2 at t_1 compared to t_0. In contrast, they worsened in stages 0 and 3. The number of patients in stage 0 increased from 1 to 3, and the number in stage 3 decreased from 10 to 2 (◆ Table 3). On separate consideration of weight and BMI progression within each stage, a reduction in both parameters was observed on average in stages 0, 1 and 2. In contrast, the average value rose in stage 3; this is due to the decrease in the number of patients in this stage from 10 to 2. Furthermore, of the two patients who were assigned to stage 3 at point t_1, one patient lost weight within the examination period, whereas the other gained weight. The mean values for weight and BMI data were higher in stages 2 and 3 at both the initial and final examinations than the values in stage 1 (◆ Table 4). Weight and associated BMI within stage 1 was only recorded for one person at point t_0 and for two at t_1.

Discussion

Analysis of the data based on EOSS classification reveals that the DOC WEIGHT® program can reduce obesity-related subclinical risk factors and obesity-related secondary/accompanying diseases. The improvement in the number of apparent comorbidities and in the lab results outside the normal range within the EOSS stages were analyzed to provide a clearer impression; this also revealed positive progress for the majority of patients. On occasion, particularly in stages 2 and 3, percentages may have worsened due to the reduction in the number of people assigned to stages 2 and 3 in favor of stages 0 and 1. Based on the observed improvements in the health of participants who were assigned to stages 0, 1 and 2 according to the EOSS, patients with subclinical risk factors and/or a lower number of comorbidities benefitted in particular from this program. This shows that patients classified in stages 0 to 2 according to the EOSS represent the target groups for the DOC WEIGHT® program.

Long-term follow-up examinations are recommended to illustrate the long-term success of the treatment program. A larger patient collective would also improve the extent to which the results can be generalized. To enable a more precise EOSS classification, the recorded parameters should be adjusted to the criteria defined by KUK et al. [6] and comprehensive data of all included parameters should be recorded by participating physicians. This was a significant limitation for the analysis of data in this study.

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Conflict of Interest
The authors declare no conflict of interest.

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DOI: 10.4455/eu.2017.021