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ORIGINAL

Effect of the depletion of self-control strength on the self-regulation of the nutritional process in obese individuals

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background Self-strength can be depleted as a result of previous acts of self-control. The depletion of these resources is reflected by decreased effectiveness of controlling other behaviors. The aim of the research was to evaluate the impact of the depletion of self-control resources on the motivational and behavioral aspects of eating self-regulation among obese people.

Material/Methods A total of 100 obese people participated in the research. In the experimental group a depletion of self-control resources technique was applied. The impact of the above method on motivational and behavioral aspects of eating self-regulation was verified through participants' answers to two items on the importance of their goals and through the tested subjects' propensity for selecting high-calorie foods.

Results Members of the experimental group exposed to the depletion of self-control resources technique had lower motivation to weight reduction measured by their answers to the importance of goals (declarative measure) and were less likely to select dietetic foods than the control subjects (behavioral measure).

Conclusions The experiment confirmed the depletion of resources reduces the beneficial effects of goal implementation. Therefore, individuals with excessive body weight should be aware that the intact resources of self-control constitute the basis for the process of slimming.

Key words obesity, self-control, ego depletion, goal implementation, weight-loss

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INTRODUCTION

Obesity is a global-scale epidemic of the 21st century [1]. In Poland, every other adult is overweight, and one in six is obese [2]. According to available research, 16.4% of Polish teenagers and children are overweight and obese [3]. Obesity is a factor considerably reducing the quality of human life. It leads to numerous psychophysical complications [4, 5]. It is recognized as a socio-cultural problem this also concerns the Polish society. This is confirmed, among others, by research on the stigmatization of obese Polish women [6]. It is also common knowledge that one of the modern psychosocial and educational problems of juvenile age involves consequences resulting from stigmatization of overweight children and teenagers, in particular girls [7]. It is also worth mentioning that the costs of treating obesity constitute a serious encumbrance of the Polish budget. According to the assessment of the Food and Nutrition Institute, excessive body weight is the cause of approximately 1.5 million hospitalizations annually [8]. Therefore, attempted insight into the factors influencing human behavior leading to overweight and obesity is becoming a subject of interest of health psychology as well as other fields of science.

Weight loss requires a change in eating habits. In most cases, people who have successfully lost weight regain it after some time. For this reason, obesity-related research programs increasingly often focus on psychological factors that impede lifestyle changes and maintaining reduced weight. According to the literature, self-regulation or self-control is one of the key determinants of weight loss maintenance [9]. The process of self-regulation permits the adjustment of own reactions to internal or external expectations and standards, so that they are not only an expression of our momentary needs not considering the perspective of priority goals [10].

The terms “self-control” and “self-regulation” are frequently used as synonyms due to their overlapping and partly similar function. Self-regulation has a wider context, as it refers to both conscious and unconscious processes. In contrast, self-control, referred to as the operational phase of self-regulation, refers to voluntary inhibition of impulses and overcoming temptations [11]. Therefore, its functioning requires the resources of self-strength. The source of the self-strength can be depleted as a result of previous acts of self-control [12]. The depletion of these resources is reflected by decreased effectiveness of controlling other behaviors. Muraven et al. [13, 14] conducted a series of studies verifying the abovementioned assumption. Some of these studies addressed the process of nutritional control. The authors focused on the behavioral aspect of self-regulation, i.e. behavior of subjects who were exposed to caloric food. The experiments conducted by Muraven et al. [13] included non-slimming individuals who did not pay too much attention to nutritional control. It was revealed that the depletion of self-control resources impaired further possibility of self-controlling one’s behavior regarding the amounts of consumed food. The link between ego depletion, self-control, and pro/un-healthy behavior was tested in terms of the process model (ego depletion impairs self-control due to increased motivation toward indulgence and decreased motivation toward the initial act of self-control) as well as the reflective–impulsive model (ego depletion results in behavior consistent with current desires and less consistent with long-term motivations) [17]. Haynes, Kemps and Moffitt partly supported both models. The authors discovered that ego depletion increased unhealthy behavior via lowered motivation, and more

importantly, they argued that desire may be an appropriate target for reducing unhealthy behavior when self-control resources vary [17].

Basing on assumption of Muraven et al. [13, 14] and Hayes et al. [17], we decided to verify the effect of the depletion on the control of dietary habits in slimming obese individuals who paid much attention to nutritional control.

The aim of this study was to analyze the influence of the depletion of self-control resources in obese individuals on their declared importance of the losing weight objective, i.e. the motivational aspect of nutritional self-regulation. We tested the behavioral sphere, i.e. the real behavior of our participants in response to caloric food stimulation, and the consistency of this behavior with the declared importance of the principal objective. It is not infrequent in real life practice that declarations are inconsistent with true behaviors.

We analyzed if obese subjects taking part in the slimming program, i.e. exposed to conditions excellently promoting nutritional control, are at higher risk of the depletion-related decrease in self-control, or rather their high level of motivation and active practicing proper habits will activate preventive control of temptation.

According to cited literature we formulated the following hypotheses:

H1. Manipulation (depletion of self-control resources) will be reflected by less frequent selection of dietetic food in the experimental group than in the control one.

H2. Upon manipulation (depletion of self-control resources), the experimental group will perceive the objectives related to slimming as less important.

MATERIAL AND METHODS

The study included 100 obese individuals (BMI > 30 kg/m^2): 52 women and 48 men aged between 30 and 58 years of age, taking part in a slimming program at the obesity center in Olsztyn, Poland. All participants gave written consent to participate in the study.

The experiment included two equally-sized groups of obese individuals: the experimental group with depleted resources of self-control and the control group. The study groups were randomized.

All participants were examined individually. Initially, we kept the experimental group ignorant of the true objective of the study, informing them that they participate in an experiment determining the influence of unpleasant stimulation on performing and repeating various tasks. In contrast, the controls were told that they take part in an experiment analyzing the influence of time on performing and repeating various tasks. Each participant was assigned a number used for encoding procedure and identification during repeated measurement of dependent variables.

In the beginning all participants were asked to assess the importance of the following goals: 1. Improvement of body shape and 2. Loss of excess weight.

The goals were evaluated on a 7-point Likert scale.

The next stage of the study took place 12 days following the initial examination. We decided that the 12-day period seemed long enough for subjects to forget their previous goal's estimations, as we wanted to measure the importance of these "slimming" goals another time during the second session. Participants from the experimental group were subjected to manipulation aimed at the depletion of their self-control resources. The experiment followed the procedure of cold-water test proposed by Muraven et al. [13]. The subjects were asked to hold one hand in a container with cold-iced water as long as possible. As this task was unpleasant, the participants' natural reaction was to withdraw the hand as soon as possible. However, they had to inhibit this natural reaction with their mechanisms of self-control. We allowed participants to keep their hand in cold water as long as they were able to. There was no time pressure.

The controls (recruited from amongst individuals with BMI > 30 kg/m^2, treated at the obesity center in Olsztyn) were not subjected to any manipulation.

Subsequently, the participants performed another task. The experimental group and the control group rated their goals 1. Improvement of body shape and 2. Loss of excess weight, as previously on 7-point Likert's scale. Subjects from the experimental group completed their goals immediately after the manipulation. The controls completed their goals the same day as the experimental group as it cannot be excluded that participation in the slimming program itself is sufficient for the resource depletion in obese individuals.

After all subjects completed their forms, everyone was informed that there was a food reward for their participation, and that they could choose one item from the list of 6: chocolate, apple, carrots, cake, grapefruit or chips. The participants indicated their reward choice by writing down what they wished to receive on a piece of paper. Subsequently, the subjects were informed that they will only receive low calorie rewards, namely apple, carrots or grapefruit, and were briefed about the true nature of the experiment.

After completing the experiment, the participants were thanked and fully briefed.

RESULTS

VERIFICATION OF HYPOTHESIS 1

According to Hypothesis 1, manipulation (depletion of self-control resources) should be reflected by less frequent selection of dietetic food in the experimental group than in the controls (behavioral measure). The analysis of variance, design: 2 group x 2 gender x 2 age (young vs. older), revealed:

no gender effect ($F < 1$),

no age effect ($F < 1$),

a trend toward effect of the group: $F(1, 96) = 3.39$, $p = 0.069$, $Eta^2 = 0.034$, M(experimental) = 1.66, M(control) = 1.82, $t(98) = 1.84$, $p = 0.060$

These results confirmed our hypothesis at a threshold of statistical significance. Indeed, individuals subjected to manipulation – resource depletion – selected dietetic refreshments less frequently.

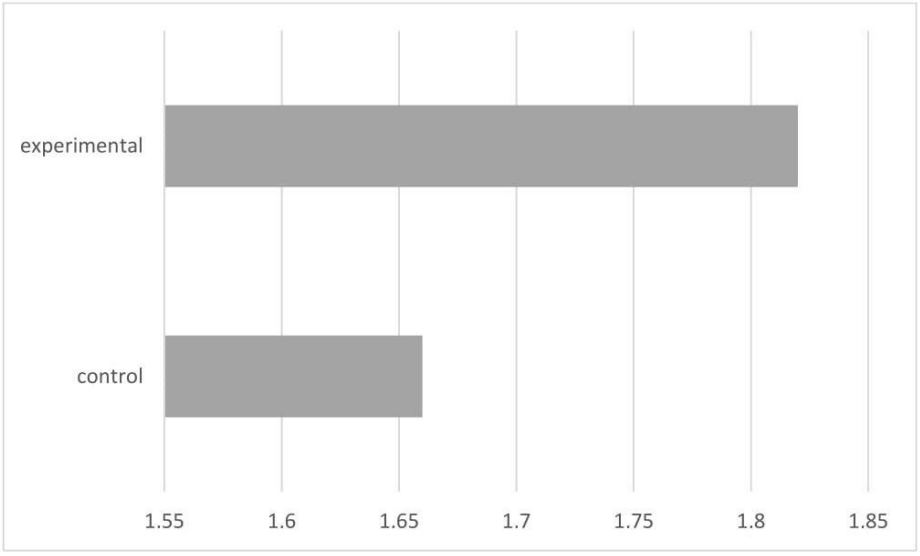

Fig. 1. Effect of group on the frequency of choosing dietetic food by obese individuals from two groups: $F(1, 96) = 3.39$, $p = 0.069$

VERIFICATION OF HYPOTHESIS 2

Hypothesis 2 stated that upon manipulation (depletion of self-control resources), the experimental group will perceive the objectives related to slimming as less important. The hypothesis was verified using repeated measures analysis of variance for between and within factors design.

In the case of the "Improvement of one's silhouette" objective for between groups design we revealed:

no gender effect: $F < 1$;

no age effect ($F < 1$);

significant effect of the manipulation (before, after): $F(1, 99) = 32.13$, $p < 0.001$, $Eta^2 = 0.25$, which supports the significance of manipulation (manipulation check);

Moreover, we ran repeated measures analysis of variance separately for the experimental group $F(1, 49) = 60.167$, $p < 0.001$, and the control group: $F(1, 49) = 0.089$, n.s. (within design). The latter result indicates that participants enrolled in the experimental group assessed differently the importance of the goal "Improvement of one's silhouette" in contrast to the control group:

experimental group: (t for dependent measures): M/before = 6.12 SD = 0.659 vs. M/after = 5.30 SD = 0.677, $t(49) = 7.757$, $p < 0.001$;

control group (t for dependent measures) M/before = 6.20 SD = 0.638 vs. M = 6.16, SD = 0. 661, t(49) = 0.299, p = 0.766;

All of the above results were supported via repeated analysis of variance: factor 1 (within analysis of variance): F(1, 98) = 45.066, p < 0.001; factor 1 x group (ego depletion vs. lack of depletion) – between analysis of variance: interaction: F (1, 98) = 40.876, p < 0.001.

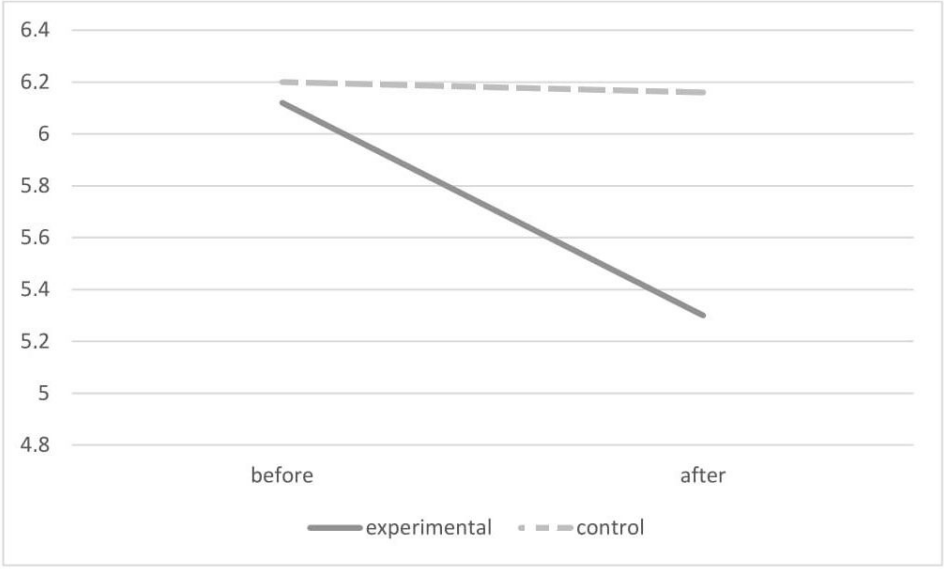

Fig. 2. Effect of manipulation – depletion of resources in the experimental group on the importance of the objective: Improvement of one's silhouette

In the case of the Losing excessive kilograms objective we ran analysis of variance for between and within factors design. We observed:

no gender effect: F < 1;

no age effect (F < 1);

significant effect of manipulation (before, after): F(1, 99) = 32.14, p < 0.001, Eta^2 = 0.25, which supports the significance of manipulation (manipulation check). Manipulation exerted the expected effect also in the case of the second objective and thus it can be concluded that our hypothesis was confirmed.

Moreover, we ran repeated measures analysis of variance separately for the experimental group F(1, 49) = 50.544, p < 0.001, and the control group: F(1, 49) = 0.00, n.s. (within design). The latter results indicate that participants enrolled in experimental group assessed differently the importance of the goal "Losing excessive kilograms" in contrast to the control group:

experimental group: (t for dependent measures): M/before = 6.20 SD = 0.670 vs. M/after = 5.24 SD = 0.686, t(49) = 7.716, p < 0.001

control group (t for dependent measures) M/before = 6.18 SD = 0.595 vs.

M = 6.18, SD = 0.595, t(49) = 0.00, p = 1.00.

All of the above results were supported via repeated analysis of variance: factor 1 (within analysis of variance): $F(1, 98) = 47.119$, $p < 0.001$; factor 1 x group (ego depletion vs. lack of depletion) – between analysis of variance: interaction: $F(1, 98) = 47.116$, $p < 0.001$.

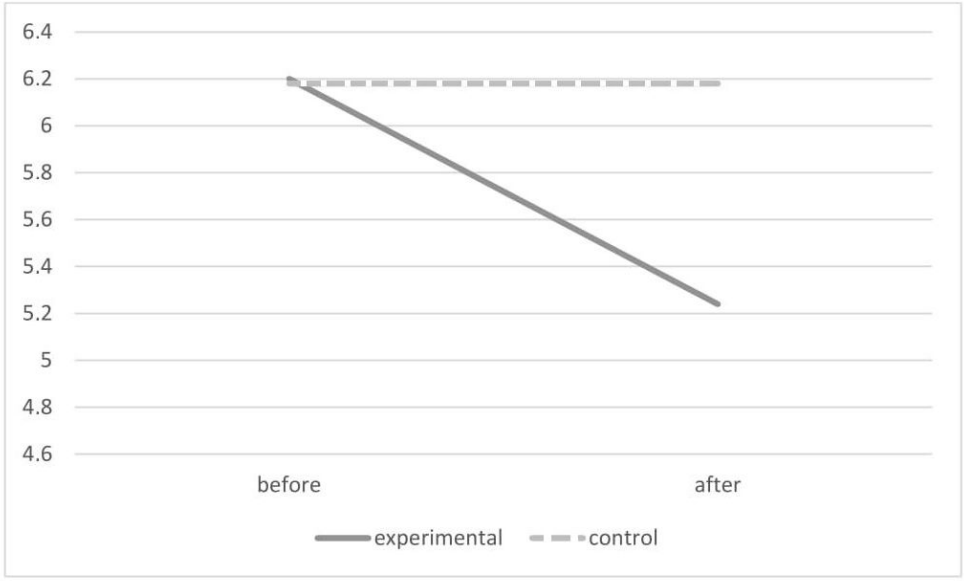

Fig. 3. Effect of manipulation – depletion of resources in the experimental group on the importance of the objective: "Losing excessive kilograms"

DISCUSSION

The aim of our experiment was to analyze the influence of manipulation related to the depletion of self-control resources on the level of surrendering to the temptation of caloric food, i.e. the behavioral aspect of self-regulation. We referred the participants' behavior related to the control of nutritional habits to their declared motivation to slim. According to theoretical background and many experiments dealing with the problem in question, the depletion of resources should decrease the level of self-control required for other behaviors, among them the control of dietary habits [13, 15, 16]. However, previously reported experiments on the self-control of nutrition revealed that a high level of motivation, involvement in the process of losing weight along with active learning and practicing proper dietary habits are reflected by the development of intrinsic, resistant to depletion self-control, which protects against the risks related to caloric food [18, 19, 20, 21]. Therefore, we assumed that verifying the effect of resource depletion is important in such an experimental group, and our findings do not necessarily have to be consistent with the results of previous studies dealing with the problem in question [13, 15, 16]. According to our first hypothesis, as a result of the manipulation individuals from the experimental group should choose dietetic food less frequently than the controls. In turn, our second hypothesis focused on the motivational sphere of losing weight and stated that manipulation will be reflected by decreased importance of this objective. Our study confirmed both these assumptions as the declarative and executive spheres proved consistent. This supports the hypothesis according to which the depletion of self-control resources

constitutes the factor which significantly endangers the effective execution of the slimming process, despite a high level of motivation and actively practicing new, proper nutritional habits.

However, there are some limitations to the present study that should inform future work. Future research on that subject could be improved by introducing slimming obese individuals not participating in a weight-loss program as well as participants with proper weight to the experiment. Also it could be interesting to recognize which factors contribute to development of obesity in participants in the context of individual differences.

CONCLUSIONS

Individuals who managed to reduce their body weight very often "get back" the lost kilograms. This situation is not unique for persons for whom the new style of life was too serious modification, unacceptable in a longer perspective. Conversely, not infrequently this pertains to obese subjects who excellently adapted to new, proper habits, and considered them a natural component of their life. They are convinced of their strong will, and believe that they permanently satisfy their principal objectives. As a result, they expose their balanced nutritional self-regulation to situations that can lead to its repeated deregulation. This occurs when we ignore the necessity of implementing proper preventive strategies during exposure to stress, intensively inhibit our natural responses in order to adjust them to social standards, or are fatigued and deficient of our self-control resources. In turn, proper preventive strategies include having regular meals protecting us against severe hunger which cannot be controlled by depleted self-control resources [22, 23]. Our study unambiguously revealed that a high level of motivation, involvement, and actively practicing dietary habits are insufficient to protect one against the temptation of caloric food in states of severe depletion. Our experiment confirmed the depletion of resources reduces the beneficial effects of goal implementation. Therefore, individuals with excessive body weight should be aware that the intact resources of self-control constitute the basis for the effective process of slimming. The results of the above study constitute important theoretical inputs, and they could contribute to the effectiveness of psychological interventions in obesity treatment.

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