



**THE EFFECT OF A COMBINED EXERCISE AND  
GOAL SETTING PROGRAM ON PHYSICAL ACTIVITY LEVELS,  
NUTRITIONAL HABITS AND SMOKING CESSATION OF  
GREEK PATIENTS WITH MULTIPLE SCLEROSIS**

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**Abstract:**

**Background.** A healthy lifestyle is crucial for patients with multiple sclerosis (MS). **Objective.** The purpose of the study was to examine the effect of a combined exercise and goal-setting program of Greek patients with MS on increasing physical activity (PA) level, adopting healthier nutritional behaviors and reduce smoking. **Methods.** The sample consisted of 30 patients with multiple sclerosis, 15 men and 15 women, aged 23 to 65 years, randomly assigned into two equal (experiment and control) groups. The experiment group participated in an 8-week exercise program combined with nutrition and goal-setting strategies with a purpose to adopt and maintain a healthier lifestyle. The control group did not participate in any of the intervention procedures. Both groups completed -pre and post intervention- questionnaires measuring their leisure time PA, nutritional behaviors and smoking dependence. **Results.** The results showed higher rates of leisure time PA, improved eating habits and reduced smoking behaviors of experiment group participants following the 8-week intervention program compared to control group participants. **Conclusions.** Based on findings, further recommendations were made concerning PA levels, nutrition and smoking cessation of patients with multiple sclerosis.

**Keywords:** multiple sclerosis patients, exercise, goal setting, nutritional behavior, smoking

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## 1. Introduction

Multiple sclerosis (MS), a chronic inflammatory demyelinating disease characterized by degeneration of the Central Nervous System (CNS) with a variety of symptoms and unpredictable alternations of periods of remission and exacerbation, is considered as one of the most representative neuromuscular diseases that affects young adults and especially women (Kutzelnigg & Lassmann, 2014). MS severely affects the nerve conduction of both motor and sensory nerves causing various degrees of disabilities (Ortiz et al., 2013) associated with slow nerve conduction, muscle weakness, loss of joint function movement, instability, blurred vision or diplopia, speech disorders, fatigue, and in more severe cases partial or complete paralysis. The severity of the symptoms of the disease varies greatly from person to person depending on the progression of the disease and which nerves are affected, making multiple sclerosis a purely personal case that each patient experiences differently (Compston & Coles, 2008).

In addition to the medical treatment of MS, important factors in helping patients include the benefits of exercise participation and balanced diet. In fact, individual lifestyle related to fitness, the types of food consumed as well as smoking can even be linked to the onset of the disease (Pozuelo et al., 2014). The high consumption of saturated fatty acids of animal origin and the lower content of vitamin D lead to the prevalence of MS (Ascherio et al., 2014). Mechanisms associated with vitamin D and smoking may potentially increase the baseline risk of disease (Wingerchuk, 2011), with vitamin D having been shown by a number of studies to be of paramount importance as its intake is inversely proportional to the onset of the disease later in life (Mirzaei et al., 2011; Munger et al., 2011).

Furthermore, research has shown strong evidence that organized, individualized, and systematic exercise helps MS patients improve their level of functionality (Romberg et al., 2005; Molt et al., 2008) and reduce fatigue (Mark et al., 2014; Dalgas & Stenager, 2010). Lai et al. (2017) have also addressed the beneficial role of regular exercise on people with MS. Thus, exercise should be an integral part of the daily life of MS patients since it brings significant benefits. Exercise combined with nutrition also plays an important role in reducing or stopping smoking, a habit recognized as the main threat to human health responsible for most causes of death worldwide, has a strong relationship with environmental factors and MS, with smokers more likely to develop the disease than non-smokers (Salzer et al., 2013). Overall, smoking has been found to be one of the most reliable environmental factors for the occurrence of the disease (Belbasis et al., 2015).

Goal-setting is one of the most widely used and highly effective behavioral change strategies for promoting peoples' PA and helping them to adopt more health-related behaviors (McEwan et al., 2016; Pearson, 2012; Shilts et al., 2004; Swann et al., 2021). For example, in a meta-analysis of McEwan et al. (2016, p. 67) results showed "*a medium, positive effect of goal setting interventions in relation to PA behaviour*". Similarly, Lorencatto et al. (2016) found that goal-setting strategy helped adult smokers to increase their

smoking quit attempts. Based on the goal-setting theory (Locke & Latham, 2006) and the SMART principles (Brown et al., 2016; Lawlor & Hornyak, 2012; MacLeod, 2012), an effective goal should be personal, specific, measurable, achievable, challenging and time-bound. Also, a goal commitment and an action plan to achieve the intended goal are essential elements for the success of this behavioral change technique (Bailey, 2017; Locke & Latham, 2002).

The majority of international research so far, has examined separately the effect of exercise or nutrition or smoking cessation programs on MS patients (Farinotti et al., 2012; Motl & Gosney, 2007; Ramanujam et al., 2015; Riemann-Lorenz et al., 2016). Moreover, the number of intervention programs or cohort studies focusing on healthier eating habits or smoking cessation of patients with MS is very small worldwide (Farinotti et al., 2012; Ramanujam et al., 2015). Reviewing the literature, it seems that no other research on MS patients has incorporate within an exercise program the application of self-determined psychological techniques such as goal setting, aiming to promote the adoption of healthier behaviors concerning nutritional and smoking habits and increase physical activity. In other words, self-setting goals seem to increase the commitment towards exercise and individual's desire to adopt a healthier lifestyle (Saini & Lacroix, 2009), nevertheless, this has not yet been investigated in patients with multiple MS. Especially in Greece, research so far has focused solely on individual factors that compose the overall health profile of MS patients (Kastanias & Tokmakidis, 2008; Karageorgou et al., 2019) without examining the effect of combined intervention programs to shape healthier behaviors of patients with MS. Therefore, the purpose of this study was to investigate the effect of a combined exercise and goal-setting program of Greek patients with MS on improving their leisure time physical activity and nutritional behaviors and reduce smoking.

## **2. Methods**

### **2.1 Participants**

The sample consisted of 30 MS patients, 15 men and 15 women ( $N = 30$ ), aged 23 to 65 ( $M = 38.70 \pm 9.53$  years) all members of the Hellenic Society for Multiple Sclerosis in the prefectures of Trikala and Magnesia and casual smokers. Following an initial briefing, all participants expressed their interest to participate in the study and signed a consent form ensuring voluntary participation in research and confidentiality of responses. Next, the participants were randomly assigned in two equal groups, that is, the experiment and the control group. The experiment group ( $N = 15$ ) participated in the combined exercise, nutrition and goal-setting intervention program, whereas the control group ( $N = 15$ ) did not participate in any of the research procedures.

## 2.2 Instruments

The questionnaires administered for research purposes to all individuals of both groups, included:

### a. Physical activity

The Greek version (Theodorakis & Hassandra, 2005) of Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985), was used to measure the intensity of weekly leisure-time PA (light, moderate or vigorous) (e.g., *“How many times a week (for more than 15’) in your free time, did intense exercise - your heart beats fast (e.g., running, long distance jogging, football, basketball, swimming, cycling?”*).

### b. Nutritional behaviors

The Nutritional Behaviors Questionnaire (Bebetsos et al., 2000) that examines the extent to which the patient feels confident enough to replace unhealthy eating habits with healthy ones (e.g., *“How confident are you that you can eat your unsalted food?”*). The responses of the thirteen items constituting a single factor, are given at a 10-degree Likert scale ranging from 1 (not at all confident) to 10 (very confident).

### c. Smoking

The Fagerström Test for Nicotine Dependence (Heatherton et al., 1991), checks patients' intensity (very low to very high) of physical addiction to nicotine per day and has been previously used in Greek population studies (e.g., Gratiou et al., 2012; Saridi et al., 2017). It consists of six items evaluating the quantity of cigarette consumption, the compulsion to use and dependence (e.g., *“How many cigarettes do you usually smoke per day?”*).

## 2.3 Procedure

The study and its procedures was evaluated and approved by the Ethics Committee Board of the Department of Physical Education and Sport Science at University of Thessaly (Ref. Number: 3-1/ 12-12-2018). Prior research commencing, all participants signed a consent form ensuring voluntary participation in research, confidentiality of responses and their free choice to drop out of the program anytime they wish to do so.

Next, participants were randomly assigned through a lottery process (1:1) into two equal groups, that is, an experiment group ( $N = 15$ ) following an 8-weeks' combined program of exercise, nutrition and goal-setting and the control group ( $N = 15$ ) that did not participate in any of the research procedures. As for the experiment group, the intervention program included an 8-week exercise program at a frequency of two to three times a week, with 20 to 30 minutes of each session that could be gradually increased to 60 to 90 minutes in the final weeks of the program based on goal setting procedures and mutual patients' choice, under the supervision of the researcher who was also an adapted physical education instructor. Furthermore, all experiment group participants were initially informed about the principles of the Mediterranean diet and the harmful health effects of smoking in a 30 minutes' session that was delivered by an independent, well-trained researcher prior program commencement.

In addition, each participant of the experiment group was informed and familiarized with self-regulated goal-setting strategies toward increasing their PA level. Every week, each individual had the opportunity to choose the place, the type, the intensity and the frequency of exercise he/she wanted to be involved and to set personal, specific, measurable, achievable, challenging, and time-bound exercise goals (“e.g., *Next week, my personal goal is to perform 30 minutes walking daily*”). Self-determined goals were also set for both the Mediterranean pyramid-based diet plan (e.g., “*Next week, my personal goal is not to drink soft drinks at all*” or “*Next week, my personal goal is to eat red meat only once*”) and smoking cessation (e.g., “*Next week, my personal goal is to smoke five cigarettes per day*”). After setting a personal goal for healthier behaviors in PA, nutrition and smoking, all individuals committed to implement their goal and set an action plan to achieve it. At the beginning of each meeting, the researcher was informed by each participant about the nutrition followed the previous days, exactly how many cigarettes each participant smoked and which delay techniques were used successfully, so as to reduce daily cigarettes’ intake according to mutual goals set at the beginning of each week. Then, the exercise session followed. At the end of each session, the researcher reminded each participant of the additional delay techniques they could use throughout the day every time they have a strong urge to smoke, such as a) take a sip of water slowly, b) take a deep breath and say the word ‘calm’, c) do something else, and d) delay lighting a cigarette for another 10 minutes. All the above information was recorded in the personal diary of each participant which was kept by the researcher as a detailed feedback of personal progress and effort made by each participant. Regarding individuals at the control group ( $N = 15$ ), they did not participate in any of the intervention procedures.

The instruments were administered for completion prior and after the intervention program to all participants of both groups. During the completion of the surveys, a research staff was present in order to answer in any questions posed by participants, without otherwise being involved during the process.

## 2.4 Statistical analysis

The Statistical Package for Social Sciences (IBM SPSS Statistics v26.0) was used for data analysis. Initially, Kolmogorov-Smirnov test (K-S) was used to verify normal distribution. Next, a two-way repeated measures ANOVA (2x2) was applied to locate possible differences in the examined variables between time (pre-post), group (experiment and control) and interaction between time and groups. In case normal distribution was violated, a Mann-Whitney  $U$  non-parametric test was used to assess possible differences between experiment and control group in post-intervention measures, while a Wilcoxon non-parametric test was contacted to examine possible differences between pre and post-intervention measurements within each group. The significance threshold was set at  $p < .05$ .

### 3. Results

#### 3.1. Descriptive statistics and normal distribution

Descriptive statistics (mean, standard deviation) and normal distribution of the examined variables in both measures (pre, post) are presented below (Table 1).

**Table 1:** Descriptive statistics (mean, standard deviation) and normal distribution of the examined variables in pre and post intervention measures

Variables	Pre		Post	
	M ± SD	K-S	M ± SD	K-S
LPA	2.90 ± 4.63	1.650*	3.60 ± 5.37	1.428*
MPA	5.50 ± 6.87	1.762**	6.33 ± 6.42	1.486*
VPA	3.60 ± 8.39	2.553**	4.50 ± 11.02	2.511**
LTPA	12.00 ± 13.25	.998	14.43 ± 12.25	.739
BMI	26.80 ± 2.98	.881	26.60 ± 3.02	.489
Smoking	2.43 ± 2.42	1.514*	2.03 ± 2.20	1.397*
Nutrition	7.54 ± 1.37	.718	7.82 ± 1.27	.545

**Notes:** M = Mean; SD = Standard Deviation; K-S = Kolmogorov-Smirnov Z test; LPA = Light Physical Activity; MPA = Moderate physical activity; VPA = Vigorous physical activity; LTPA = Leisure-time physical activity; \*  $p < .05$ ; \*\*  $p < .01$ .

#### 3.2 Differences between experiment and control groups on health behaviors (physical activity, smoking, nutrition) and Body Mass Index (BMI)

Two way ANOVAs with repeated measures revealed significant interactions between time and group on LTPA (Wilks'  $\lambda = .852$ ,  $F_{1,28} = 4.878$ ,  $p < .05$ ,  $\eta p^2 = .15$ ) and food consumption (Wilks'  $\lambda = .779$ ,  $F_{1,28} = 7.952$ ,  $p < .01$ ,  $\eta p^2 = .22$ ). Additional analysis of these interactions revealed significant differences on LTPA ( $F_{1,28} = 6.800$ ,  $p < .05$ ,  $\eta p^2 = .20$ ) and food consumption ( $F_{1,28} = 15.905$ ,  $p < .001$ ,  $\eta p^2 = .36$ ) between pre and post measures only for the participants of the experiment group following the intervention program, with significantly higher scores achieved in post measures (Table 2). Similarly, significant differences were found in LTPA between experiment and control group in post measures. Participants at the experiment group reported higher scores in LTPA compared to those in control group after the implementation of the intervention program (Table 2). In contrast, no significant interactions were noted between time and group on BMI (Wilks'  $\lambda = .910$ ,  $F_{1,28} = 2.761$ ,  $p = .108$ ,  $\eta p^2 = .09$ ).

Mann Whitney  $U$  test revealed no statistically significant differences on LPA post-intervention scores ( $U = 92.50$ ,  $p = .01$ ) between experiment and control group. Similarly, Wilcoxon test showed no significant differences on LPA between pre and post measures both for experiment group ( $Z = -1.809$ ,  $p = .70$ ) and control group ( $Z = -1.000$ ,  $p = .317$ ). As for MPA, Mann Whitney  $U$  test revealed statistically significant differences on post-intervention scores ( $U = 41.50$ ,  $p < .01$ ) between experiment and control group, with significantly higher scores achieved in post measure (Table 2). In contrast, Wilcoxon test

showed no significant differences on MPA between pre and post measures both for experiment group ( $Z = -1.078, p = .281$ ) and control group ( $Z = -.816, p = .414$ ).

Mann Whitney  $U$  test revealed no statistically significant differences on VPA post-intervention scores ( $U = 80.50, p = .06$ ) between experiment and control group. Similarly, Wilcoxon test showed no significant differences on VPA between pre and post measures both for experiment group ( $Z = -.552, p = .581$ ) and control group ( $Z = -.000, p = 1.00$ ).

As for smoking, Mann Whitney  $U$  test revealed no statistically significant differences on post-intervention scores ( $U = 91.50, p = .361$ ) between experiment and control group. In contrast, Wilcoxon test showed significant differences on smoking between pre and post measures only for experiment group ( $Z = -2.414, p < .05$ ), with significantly lower scores achieved in post measure (Table 2).

**Table 2:** Differences between experiment and control group on health behaviors (physical activity, smoking, and nutrition)

Variables	Experiment group		Control group	
	Pre (M ± SD)	Post (M ± SD)	Pre (M ± SD)	Post (M ± SD)
LPA	2.40 ± 3.62	4.00 ± 5.28	3.40 ± 5.54	3.20 ± 5.61
MPA	7.33 ± 7.53	10.00 ± 6.27 <sup>a</sup>	3.67 ± 5.81	2.67 ± 4.17 <sup>a</sup>
VPA	6.60 ± 11.01	8.40 ± 14.62	.60 ± 2.32	.60 ± 2.32
LTPA	16.33 ± 16.36 <sup>b</sup>	22.40 ± 11.38 <sup>b, c</sup>	7.67 ± 7.42	6.47 ± 6.72 <sup>c</sup>
BMI	26.62 ± 3.19	26.32 ± 3.33	26.98 ± 2.87	26.87 ± 2.76
Smoking	2.33 ± 2.16 <sup>d</sup>	1.53 ± 1.46 <sup>d</sup>	2.53 ± 2.72	2.53 ± 2.72
Nutrition	7.56 ± 1.43 <sup>e</sup>	8.11 ± 1.01 <sup>e</sup>	7.52 ± 1.36	7.52 ± 1.45

**Notes:**  $M$  = Mean;  $SD$  = Standard Deviation; LPA = Light Physical Activity; MPA = Moderate physical activity; VPA = Vigorous physical activity; LTPA: Leisure-time Physical Activity; BMI: Body Mass Index; <sup>a, c</sup> Significant differences on MPA and LTPA between experiment and control groups; <sup>b, d, e</sup> Significant differences on LTPA, smoking and food consumption between pre and post measures only for the experiment group.

#### 4. Discussion

People with MS do not seem to differ from people without MS for any of the individual factors associated with PA levels, smoking habits and their intention to adopt a healthier nutrition in the future (Karageorgou et al., 2019). This is probably due to the lack of information on nutrition and smoking habits but also due to health complications experienced by the chronic condition of the disease itself (Esposito et al., 2017). Thus, the purpose of the present study was to investigate the effect of a combined exercise and goal-setting program on Greek patients with MS in order to increase their PA, maintain a healthy eating plan and reduce smoking.

Following intervention, experiment group participants reported higher scores in their PA levels (MPA, LTPA) compared to control group individuals, probably attributed to their own decision to choose how to structure their exercise program (choose of place, type of exercise, frequency and intensity) in combination with their personal goals set

with the guidance and mutual agreement of the well-trained scientific staff at the beginning of each week. Casey et al. (2017) similarly stated that goal setting had a positive relation with PA levels increase of MS patients, whereas Latimer-Cheung et al. (2013) further revealed that higher PA levels of MS patients were positively related to exercise of moderate intensity. On the other hand, Miller et al. (2005) in their earlier study observed that individuals with MS preferred to exercise with mild intensity compared to participants without disabilities as well as patients with other diseases who mainly choose to exercise with moderate intensity. Thus, it seems that over the years MS patients receive more information and feedback about the benefits of exercise and the level of intensity that they can determine, which in turn leads to a gradual increase of the intensity level of exercise chosen. Quite clearly, MS participants no longer feel that the disease is an inhibitory factor toward participation in physical activity, up to the extent they would prefer and decide their own level of exercise intensity according to their own desire and personal decision. In this regard, Fragooso et al. (2008) noted that an exercise program for MS patients should be progressive in terms of exercise intensity so as to have a positive effect on maintaining or even improving their health status.

In addition, post measures showed that experimental group individuals reduced smoking and improved their eating habits as a result of their own decision to gradually reduce the number of cigarettes they smoke each week and to structure a healthier nutrition plan they could follow each week as the intervention program progressed. Quite clearly, goal setting played an important role of this positive behavior change since it increased their motivation and self-confidence to meet their self-set goals to reduce smoking and improve their physical activity and nutritional habits until the completion of the exercise program. In this regard, Wilson and Brookfield (2009), noted that following a six-week exercise and goal setting program all participants of their study achieved higher scores on their motivation level, perceived choice and enjoyment. Based on the above, goal-setting seems to work in MS patients as a motivator to continue to improve their health-related behaviors and status. Thus, it could be suitably recommended for use and application by exercise specialists and/or health care professionals as a strategy to change or improve health behaviors of MS patients. The above results are in line with the vast majority of studies showing that goal-setting strategy is probably one of the strongest facilitators of improving physical activity levels, dietary and smoking behaviors (Lorenatto et al., 2016; McEwan et al., 2016; Shilts et al., 2004; Swann et al., 2021).

In contrast, no differences were observed for control group individuals between pre and post measurements, since MS patients of the control group did not appear to have the desire to change their daily lifestyle without any additional guidance. This in turn shows that MS patients need some initial guidance, information and support by specialized scientific staff, so as to set their own goals for a more active life that will include more exercise and healthier habits. Thus, the implementation of combined



exercise and goal setting programs such as this of study is essential to motivate MS patients to adopt a more active and healthier lifestyle.

A limitation of the present study was the small number of participants with MS and the use of self-report measures to record their PA levels, nutritional habits and smoking incidence, since it is well known that self-report measures are vulnerable to recall bias (Spitzer & Weber, 2019). Therefore, it is recommended to future researchers to use motion sensors (accelerometers) to record the PA levels of MS patients as well as keeping daily notes regarding nutrition or smoking. Another limitation was the absence of a follow-up study, thus, future researches should incorporate a follow-up measure three to six months following the completion of their research, to ascertain whether the impact of the intervention program had a long-term effect on health-related behaviors.

Overall, the exercise program of this study combined with the self-set goal strategies regarding PA, nutrition and smoking reduction, led to a significant reduction of smoking as well as in the adoption of healthier nutritional behaviors and higher PA levels in all post measurements of the experiment group. In conclusion, the results of this research highlight the importance of the procedures proposed, in the context of providing initial information, support and throughout guidance as a prerequisite to increase exercise participation, foster healthier nutrition habits and reduce smoking of MS patients by using a personal goal-setting approach. In this way, MS patients might adopt an active role and become the ones responsible for a healthier and more active lifestyle for their own benefit (Riccio & Rossano, 2015).

### **Conflicts of interest**

The authors declare that there are no conflicts of interest.

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