Aerobic Exercise and the Placebo Effect: A Controlled Study

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An experiment was conducted with 48 healthy young adults engaged in a supervised 10-week exercise program to determine whether a placebo effect is involved within the exercise-psychological enhancement connection. Based on an expectancy modification procedure, one-half of the subjects were led to believe that their program was specifically designed to improve psychological well-being (experimental condition) whereas no such intervention was made with the second half (control condition). Expectations for psychological benefits and aerobic capacity (VO_{2max}) were measured before and after completion of the program. Self-esteem, as the indicator of psychological well-being, was measured on four specific occasions: at the beginning, after the fourth and seventh weeks, and upon completion of the training program. The results showed similar significant increases in fitness levels in both conditions. Moreover, self-esteem was significantly improved over time in the experimental but not in the control condition. These findings provide evidence to support the notion that exercise may enhance psychological well-being via a strong placebo effect. Implications of the results with regard to exercise prescription are discussed.

Key words: exercise, placebo effect, self-esteem, psychological enhancement, aerobic capacity.

INTRODUCTION

Despite a growing body of popular and scientific literature supporting the notion that exercise enhances psychological well-being, the question of how this effect operates remains unanswered (1). Different physiological, biochemical, and psychological hypotheses have been proposed but at the present time, because of conceptual as well as methodological inadequacies, no single theory has received substantial empirical support (2–5). Difficulties in reaching a clear consensus around those proposed mechanisms have given additional impetus to the provocative hypothesis that exercise enhances psychological well-being via a strong placebo effect (6).

Shapiro and Shapiro (7) define a placebo as "any therapy or component of therapy that is deliberately used for its nonspecific, psychological, or psychophysiological effect, or that is used for its presumed specific effect but is without specific activity for the condition being treated" (p. 372). A placebo effect is defined as "the psychological or psychophysiological effect produced by placebos" (7) (p. 372). The placebo effect has been the subject of steadily growing interest during the last four decades (8). Since the mid-1940s, it has been common practice in medical research to test new drugs by comparing them with pharmacologically inert placebos under double-blind conditions. Similar practices have also emerged in psychotherapy research, and there has been growing recognition of the fact that the placebo effect itself is therapeutic (9). Along these lines, Shapiro and Morris (10) went as far as to claim that the "placebo effect is an important component and perhaps the entire basis for the existence, popularity, and effectiveness of numerous methods of psychotherapy" (p. 369). Initially viewed as an artefact to be controlled for, the placebo effect is now considered a powerful psychological mechanism in itself (11). Some authors have even suggested that the placebo effect should be maximized in all therapeutic treatment so as to favor patient well-being (12, 13), although no consensus has been reached regarding this position (14).

The hypothesis that a placebo effect is involved within the exercise-psychological influence cannot be ruled out at the present time, especially as current results from exercise psychology research provide some support for the presence of such a mechanism. The most widely accepted cognitively based explanation for the placebo effect is that it is based on patients' expectations of therapeutic benefit. According to Lundh (9), it is a well-established fact that medical and psychological treatments may lead to beliefs taking the form of: "this treatment is going to cure me" and such placebo beliefs, similar to Bandura's definition of outcome expectancies (15), may add to the therapeutic results. In North America, people's expectations of psychological benefit from

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exercise are particularly high because "the popular and professional cultures of the 1980s have led people to assume that exercise is associated with psychological health and well-being" (1) (p. 21). More precisely, the psychological benefits of exercise, especially jogging, have been propagandized by the popular press and a vast majority of magazine articles have highlighted its tension and stress-reducing effects. Consequently, those who enroll in an aerobic training program expect to reap as many psychological as biological benefits (16–18). As indicated by Folkins and Sime (3), "it is then plausible to hypothesize that self-selected, motivated volunteers in an experiment may demonstrate improvement in psychological functioning simply because they are expecting such self-enhancement" (p. 386).

From a methodological standpoint, most contemporary studies reporting a psychological improvement from exercise cannot eliminate the possibility that a placebo effect was present to some extent. Use of inadequate research strategies is the primary cause. In effect, as previously suggested by Morgan (19), "use of a control group in such experimentation should be viewed as a *necessary* not a *sufficient* design consideration. It is equally important, indeed, it is imperative, that a placebo group or sham strategy be routinely employed" (p. 300). Unfortunately, most of the studies reviewed have not relied upon such a design strategy (1–2). This is especially true of earlier studies which were, for the most part, of a preexperimental nature (3). Recent years have, however, witnessed the emergence of a number of experimental studies that have incorporated the assessment of subjects' expectations in order to control for a potential placebo effect (20–22). This procedure constitutes a real methodological improvement over past research, although it is still not adequate for verifying the presence of a placebo effect. Indeed, to statistically smooth out any differences in expectations will not necessarily eliminate the possibility that a placebo effect may exert a similar influence upon the psychological variable in both experimental and control conditions.

Double-blind designs, such as those used by pharmacologists, are indeed the most appropriate to test the influence of a treatment "per se." However, because of the high expectations now rooted within the population, it is practically impossible to verify the influence "per se" of exercise upon psychological components. An interesting alternative allowing for the verification of the eventual occurrence of a placebo effect within a treatment was recently proposed. This strategy, named "the expectancy modification procedure" (11), is designed to experimentally induce an expectancy of improvement. Because placebo and influence "per se" of a treatment are widely assumed to be additive (23), the presence of a placebo effect can thus be inferred when, during the course of a same treatment, subjects in the experimental group (i.e., higher expectations) show a higher psychological improvement than those in the control group (i.e., lower expectations). Based upon an identical research strategy, the present study was designed to assess the influence of induced expectations of improvement from exercise upon psychological well-being. Specifically, it was hypothesized that exercisers would reap more psychological benefits when they are led to believe that their training program is designed to produce such gains.

METHODS

Subjects

Subjects were 48 healthy young adults (24 men and 24 women) recruited through the mass media to participate in a study about a *Health and Fitness Project*. Most subjects were students registered at the local university. The average age of the men and women was 26.3 ± 5 and 24.7 ± 4 years, respectively. To be included in this study, these subjects had to meet the following criteria: a) consent to train at the university sports center within the context of a supervised training program three times a week in sessions lasting 90 minutes for a duration of 10 consecutive weeks; b) acceptance of a random assignment; and, c) limitation of their weekly training to the prescribed program for the duration of the study. Subjects were not paid but, as a token of gratitude, their admission to the training program was free and an individualized report of their physiological and psychological evolution throughout the program was offered at the end of the study. This study was approved by the University Human Studies Committee, and after an explanation of the purposes and procedures, all participants gave written informed consent. The consent form was neutral. All subjects had to sign their consent form before random allocation to either the experimental or the control group. At this time, the only information available to them was that two aerobic programs were offered free of charge. Aside from their own expectations at the time of signature, no other information regarding the nature of the possible outcomes from participation was provided.

Training Programs

Of the 48 subjects retained for the study, 24 were randomly assigned to the experimental training program (expectancy manipulation) and the remaining 24 subjects to the control training program while maintaining a balance for sex in each program. Both training programs were identical in length (i.e., 10 weeks), in the number of weekly training sessions (i.e., three per week), and in the number of minutes per session (i.e., 90 minutes). The format of each session was identical for both conditions: 10 minutes warm-up, 70 minutes training session, and 10 minutes

cool-down. Both programs mostly consisted of group activities such as jogging through city streets, aerobic dancing, swimming pool games, playing soccer, etc. All experimental and control training sessions took place in a group under the supervision of the same two leaders, one male the other female, both graduate students in physical activity sciences and specialized in group exercise leadership. Experimental subjects trained every week on Monday *A.M.*, Wednesday *P.M.*, and Friday *A.M.* whereas control participants were scheduled on Monday *P.M.*, Wednesday *A.M.*, and Friday *P.M.* Moreover, a fourth optional weekly training session was also available on Tuesday *P.M.* and Thursday *A.M.* for experimental and control subjects, respectively, who had some temporary difficulties with the fixed schedule. At the end of the 10-week programs, four subjects (two in the experimental and two in the control conditions) had dropped out because of time constraints and incapacity to comply with specific program requirements. The remaining 44 subjects (22 men and 22 women) attended at least 25 of the possible 30 sessions and underwent all of the required measurements.

Expectancy Manipulation

According to Lundh (9), beliefs are communicated most persuasively if "the [doctor] behaves in such a way that he is perceived as trustworthy, and an expert in his field. Moreover, his belief in the efficacy of the treatment will be communicated most effectively if he shows genuine optimism and enthusiasm with regard to the treatment. Apart from the interest and enthusiasm displayed by the [physician], then, the nature of the verbal information is also of great importance" (pp. 136).

Exercise leaders were thus selected and trained according to these recommendations. At the beginning of the 10-week exercise program, experimental subjects were first informed by exercise leaders that their training program was designed to improve both aerobic capacity and psychological well-being. Moreover, throughout the program, subjects were systematically reminded of these objectives and invited to selectively attend to signs of biological and psychological improvement. In the control condition, exercise leaders were instructed to behave in a similarly enthusiastic manner. However, from the beginning to the end of the program, emphasis was put only on the biological aspect of the exercise program. At no time during the entire program did exercise leaders mention psychological benefits as a potential effect of the exercise program.

Variables Measured

All measures were collected over a 12-week period. Subjects were not informed of their physiological and psychological scores during the entire period.

Fitness measurement. Aerobic training is primarily designed to increase the efficiency of the oxygen transport system. Thus, in order to verify the efficiency of the training programs, fitness level was assessed in the laboratory by the measurement of maximum oxygen uptake (VO_{2max}) 1 week before the first training session and again upon completion of the program. This procedure was selected because the level of oxygen consumption at maximal effort represents the most valid measure of this construct (24). As suggested by Wasserman and colleagues (25), a 1-minute incremental test on an electronically braked ergometer (Corival 400, Quinton, Seattle, WA) was adopted to measure fitness level. The overall testing procedure was the following: First, resting values were obtained during 4 minutes of sitting quietly on the ergometer prior to stress testing. Then, after 2 minutes of unloaded pedaling, the workload was incrementally increased by 20 watts/minute until exhaustion. A respiratory exchange ratio equal to or greater than 1.1 was the criterion for the achievement of VO_{2max}. The average test duration was 9 ± 3 minutes. Heart rate was obtained from ECG recordings at the end of each minute. Ventilation, VO_2, and VCO_2 were recorded every 30 seconds throughout the test by way of a computerized metabolic cart (P.K. Morgan).

Psychological health and well-being. Self-esteem, defined as the degree to which individuals feel positive about themselves (26), was the psychological construct selected to describe overall psychological health and well-being among participants. Indeed, self-esteem has been identified as the variable with the greatest potential to reflect psychological benefits from exercise (3, 27, 28). Self-esteem was measured by the Rosenberg Self-Esteem Scale (SEI), which is viewed as one of the best instruments for evaluating overall self-regard (29). This instrument includes 10 items. For every item, subjects are instructed to indicate on a 4-point Likert scale the extent to which they agree or disagree. Possible total score of all items ranges from 10 to 40, higher scores indicating higher self-esteem. The SEI was administered on four specific occasions: at the beginning of the training program, after the fourth and seventh weeks, and upon completion of the training program. This multiple measurements procedure, carried out over a period of weeks, was preferred to the usual two point (pre-post) measurements for its potential to provide a better understanding of the process of change in a psychological variable that may result from participation in a regular exercise program (20) For every testing occasion, self-esteem was measured at the end of the training session.

Self-perceptions. In order to verify the effectiveness of the experimental manipulation throughout the entire period, subjects' self-perceptions were assessed before and after the 10-week exercise program. At the initial meeting, after respective briefing, subjects in each condition filled out a questionnaire in which two questions, embedded among the others, asked them to indicate how effective they expected their training would be for improving their: (1) physical fitness and (2) psychological well-being. Both responses were based upon 7-point scales (e.g., 1 = not at all effective; 7 = very effective). After completion of the 10-week exercise program, at the end of the last training session, an adapted version of the same questionnaire was used. This time, subjects were asked to indicate on a similar 7-point scale how effective they had found their training for improving their: (1) physical fitness and (2) psychological well-being. In addition, subjects were asked to indicate the extent to which they enjoyed participating and whether they would recommend the program to a friend. Both responses were arranged on a 7-point scale ranging from "not at all" to "extremely."

RESULTS

Manipulation Checks

The mean scores for the first and second measures of perceived effectiveness of the program on psychological well-being and physical fitness are presented in Table 1. To determine whether the experimental manipulations were successful, a 2 (group) by 2 (time) repeated-measures analysis of variance (AN-

TABLE 1. Means and Standard Deviations on Measures of Self-Perceptions Before and After the Exercise Program

Group Measure		Experimental		Control	
		Pre[a]	Post	Pre	Post
Psychological well-being	M	6.36	5.91	5.40	5.27
	SD	0.65	0.85	1.43	1.27
Physical fitness	M	6.59	6.50	6.27	6.45
	SD	0.66	0.80	1.20	0.67

[a] Pre, pre-exercise; post, post-exercise.

OVA) was performed for each perception. As expected, the first analysis revealed that the subjects assigned to the experimental condition perceived their exercise program as more psychologically effective than did those assigned to the control condition $F(1,42) = 7.02$, $p < 0.01$. However, from the beginning to the end of the training program, this placebo belief tended to decrease in strength $F(1,42) = 3.87$, $p = 0.06$ although this phenomenon was not confined to the experimental group but rather, was found to be common to both conditions as indicated by the nonsignificant group by time interaction $F(1,42) = 1.34$, $p > 0.10$. Moreover, there was no significant group by time interaction on measures concerned with the perceived effectiveness of the program on physical fitness, and all other main effect tests failed to approach conventional levels of statistical significance ($p > 0.10$). Finally, as measured after program completion, the subjects' level of enjoyment concerning their respective program was similar $F(1,42) = 0.25$, $p > 0.10$ and significant for the experimental (M = 5.45) and the control (M = 5.54) subjects. Participants in both experimental (M = 6.27) and control (M = 6.41) conditions were also unanimous $F(1,42) = 0.18$, $p > 0.10$ in strongly recommending their respective training program to their friends. In summary, experimental and control groups differed from each other only on perceived effectiveness of the program on psychological health and well-being. It was then concluded from these results that the experimental manipulations had been successful.

Aerobic Capacity

Group means for the VO_{2max} data measured before and after the training programs are presented in Table 2. To determine whether the aerobic exercise training led to reliable increases in physical fitness, a 2 (group) by 2 (time) repeated-measures analysis of variance (ANOVA) was conducted on maximum aerobic capacity scores. The analysis yielded a significant difference among the pre- and postmeasures $F(1,42) = 16.09$, $p \leq 0.001$. However, neither the main effect for group nor the group-by-time interaction reached statistical significance ($p > 0.10$). These results, therefore, indicate that, after participating in the experiment, fitness benefits were significant and about the same from one exercise condition to another.

Self-esteem

Table 3 contains the means and standard deviations for the two groups on the self-esteem scores. In order to examine the evolution of psychological health and well-being across the various phases of the investigation, a 2 (group) by 4 (time) repeated-measures analysis of variance (ANOVA) was performed on self-esteem scores. There was no main effect for group ($p > 0.10$). However, a significant main effect for time $F(3,126) = 17.67$, $p \leq 0.001$ and, more important, a significant group-by-time interaction $F(3,126) = 5.47$, $p \leq 0.01$ were reported. As illustrated in Figure 1, these latter results therefore suggest that the evolution of self-esteem over time was not the same under each exercise condition. Further repeated-measures analyses of variance on the self-esteem scores within each condition revealed that psychological well-being was significantly improved over time in the experimental condition $F(3,63) = 20.3$, $p \leq 0.001$ but not in the control exercise condition $F(3,63) = 2.22$, $p = 0.09$, although this latter result strongly suggests a trend toward significance. There were no reliable differences among the groups at the first $F(1,42) = 0.15$ and at

TABLE 2. Means and Standard Deviations on Measures of Fitness (ml/kg/min) Before and After the Exercise Program

Time Group	Pre-Exercise	Post-Exercise
	M ± SD	M ± SD
Experimental	50.49 ± 11.51	52.49 ± 11.31
Control	48.64 ± 11.17	49.89 ± 11.48

TABLE 3. Means and Standard Deviations on Measures of Self-Esteem During the Exercise Program

Group Time (weeks)	Experimental	Control
	M ± SD	M ± SD
1	31.32 ± 4.36	31.81 ± 4.07
4	33.04 ± 3.92	32.32 ± 3.71
7	34.68 ± 3.33	32.45 ± 3.69
10	35.23 ± 2.96	33.18 ± 4.25

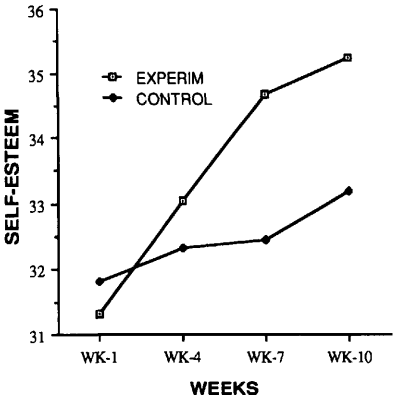

Fig. 1. Self-esteem scores for subjects in the experimental and control conditions at the 1st, 4th, 7th, and 10th weeks of the exercise program.

the fourth week $F(1,42) = 0.4$. However, group differences reached statistical significance at the seventh week $F(1,42) = 4.43$, $p < 0.05$, and there was a trend that approached statistical significance for the group differences at the 10th week $F(1,42) = 3.44$, $p = 0.07$.

DISCUSSION

The results of this investigation provide additional support for the notion proposed by Solomon (6) that a placebo effect may be involved within the exercise-psychological enhancement connection. Obviously, the findings indicated that the experimental subjects, whose expectations for psychological benefits were strengthened by an expectancy modification procedure, improved their self-esteem more during the 10-week exercise program than did the control subjects.

Although a number of biological and psychological mechanisms have been proposed to explain the exercise and psychological functioning, the observed difference in self-esteem evolution between the two exercise groups can hardly be explained by either mechanism. On the one hand, a popular biological theory states that psychological improvement from exercise is due to increased aerobic capacity (30). Within the context of the present study however, this hypothesis cannot be retained as measures of aerobic capacity at maximal effort reflected similar increases in fitness levels for both experimental and control subjects. On the other hand, a prevailing psychological theory maintains that psychological improvement gotten from exercise can be attributed to psychosocial components inherent to the exercise program (27, 31). This theory is also unable to account for the present findings because the psychosocial factors maintained were similar and constant throughout both programs. Indeed, the frequency, duration, and format of the training sessions were identical for the two programs as were the exercise leaders and the group context. Confidence in the effectiveness of our control procedures is strengthened by the fact that satisfaction measures collected upon program completion were similar for both groups. Consistent with previous research (11), the present findings, therefore, strongly support the view that the placebo effect is a powerful psychological mechanism in itself.

Although the observed difference in psychological evolution between the two groups is likely attributable to a placebo effect, it cannot, however, be concluded from the present findings that it is the sole mechanism explaining the beneficial influence of exercise upon psychological well-being. From a methodological viewpoint, a pure placebo effect can be inferred only when the control group neither expects nor shows any specific improvement from a placebo treatment (9). This was not the case with the present investigation. Consistent with previous finding (1, 3), our control subjects were found to hold high basal expectations for psychological benefits from their program even without experimental treatment. Moreover, their psychological improvement throughout the program approached statistical significance. Consequently, the hypothesis that mechanisms other than the placebo effect are also involved within the beneficial influence of exercise upon psychological well-being cannot be ruled out at the present time.

Regardless of the potential mechanisms that might explain the influence "per se" of exercise upon psychological well-being, the present findings nevertheless have important implications for exercise prescription among nonclinical populations. Until now, the most spectacular psychological benefits of exercise have been reported primarily for people who are clinically anxious or depressed whereas inconsistent and mitigated results have generally been found with nonclinical populations (1–5). A possible explanation for the discrepancy in results is that clinically anxious or depressed persons are particularly receptive to a placebo effect because they generally hold higher expectations for psychological benefits (e.g., this treatment is going to cure me) from a specific intervention than nonclinical popu-

lations (32). In this regard, the findings of the present study indicate that it is possible to induce psychological improvement among nonclinical exercisers if, via an expectancy modification procedure, they are explicitly led to believe that their program is designed to produce such benefits. From an ethical viewpoint, however, no consensus has been reached concerning the deliberate use of the placebo effect in psychological interventions (14). This remains an open debate that the present study cannot solve.

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