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Effects of Face-to-Face Education on Vitamins Consumption Using Protection Motivation Theory

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Abstract

Background: Exposure of humans to toxic metals particulates was capable of inducing free radicals and cause health problems even at low concentrations, in course of time. Therefore, it is necessary to evaluate the antioxidants consumption behavior in high-risk groups for ameliorating metals toxicity. Objective: This study examined the effects of face-to-face nutritional interventions based on the Protection Motivation Theory on vitamins E and C Consumption among cement factory workers. Methods: This study is a randomized control trial which was conducted in Kurdistan Province of Iran. Participants were divided into two 70-worker groups: control and face-to-face intervention. The vitamins E and C intake were measured by using a Food Frequency Questionnaire and perceived severity, perceived vulnerability, response efficacy, self-efficacy, intention, and knowledge were assessed by Protection Motivation Theory questionnaire. Workers completed questionnaires before and after the training. The content of intervention education included lectures with Power Point presentations, discussion, individual counseling, and educational pamphlets and booklets. The control group received no educational or counseling sessions. Data analyses were done using SPSS 24.0. Results: Results showed that workers had higher mean scores of Protection Motivation Theory constructs, knowledge and vitamins C and E at post education in the intervention group compared to baseline ($P<0.001$). Moreover, the intervention group achieved higher scores compared to the control group after intervention ($P<0.001$). Significant changes on constructs, knowledge and vitamins E and C consumption were not observed in the control group after education. Conclusion: Implementation of the face to face education intervention based on Protection Motivation Theory among cement factory workers is an effective tool to increase vitamins consumption in this target sample. Findings are encouraging regarding the use of nutritional educations based on Protection Motivation Theory within factories where workers have higher levels of exposure to toxic metals to improve worker s' eating behavior.

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Introduction

Previous studies showed that the blood of workers and the residents of the neighboring communities at cement plants contained elevated levels of toxic metals compared to controls indicating an increased occupational exposure (Babalola & Babajide, 2009; Salh, Mohammed & Salih, 2014). Exposure of humans to toxic metals particulates was capable of inducing free radicals and cause health problems like cardiovascular diseases, cancers, liver, kidneys, gastrointestinal and nervous systems in people living near and working in the cement factory (Mohammadnabizadeh, Afshari & Pourkhabbaz, 2013). Therefore, workers should consider the use of rich food-antioxidants such as E and C to protect themselves against various toxic metals and deleterious free radical attacks (Gurer and Ercal, 2000).

Studies indicated that educational interventions in the workplace focused on behavioral approaches are effective in reducing risk factors and increasing the knowledge that can lead to an increase in health behaviors (Abareshi et al., 2015). The theories help to make healthy action and intention that are health promotive (Dowd et al., 2016). The failure of educational attempts alone to develop behavioral changes demonstrates the necessity for theory-based research to systematically recognize factors that may be effective in health related behaviors (Hermann, Brown & Heintz, 2009). The Protection Motivation Theory (PMT) is a social-cognitive model that was created as a model of health promotion. PMT explains health related behavior change by two processes: coping appraisal (response efficacy and self-efficacy) and threat appraisal (perceived vulnerability and severity) (Dowd et al., 2016). Perceived severity refers to the degree of harm from the unhealthy behavior and perceived vulnerability is the probability that one will experience harm (Baban & Craciun, 2007). Self-efficacy is the belief that one can successfully enact the recommended behavior and response efficacy concerns beliefs that adopting a particular behavioral response will be effective in reducing the threat (Tulloch et al., 2009). Coping and

threat appraisal combine to create intention to adopt a protective behavior (Floyd et al., 2000) (figure 1).

PMT has been successfully applied to many health promotion behaviors (Dowd et al., 2016; Calder, Davidson & Ho, 2011). However, to our best knowledge, there is no research on vitamins E and C consumption behavior among factory workers based on this theory. The promotion of sufficient antioxidants consumption particularly in high-risk groups such as factory workers with high exposure to toxic metals is an important public health issue. Previous studies have reported that individuals have not, as yet, adopted the minimum recommended levels for the consumption of vitamins (Omidvar et al., 2003). This study aimed at investigating the effects of the face-to-face nutritional education based on PMT on vitamins E and C consumption among cement factory workers.

Materials and Methods

Trial design

This study is a randomized control trial which was conducted among cement factory workers in Kurdistan Province of Iran.

Participants

Participants were assigned from cement factory workers (Munro et al., 2005). Based on the criteria, 140 were randomly selected for the intervention study using a random number table. Loss of subjects from the study sample occurred due to the following reasons: not meeting inclusion criteria (n=75), declined to participate (n = 15) (Figure 2). Workers were divided into two groups: control (n=70) in night shift and face-to-face intervention (n=70) in day shift. These methods were utilized to reduce the effect of the educational group on the control that could contaminate an experiment and produce tainted results.

Inclusion criteria

Individuals were eligible for inclusion if they did not present a history of, or current, physical symptoms of serious neurological, cardiovascular, renal, hepatic, endocrine, metabolic or gastrointestinal disease and previous pharmacological treatment, according to the medical reports available at the factory.

Exclusion criteria

Having the above mentioned items and not having satisfaction to participate in the intervention.

Measurements

PMT constructs were adopted based on previous food consumption behavior studies (Dowd et al., 2016; Calder, Davidson & Ho, 2011). To obtain content validity, five experts (Ph.D. level) in health behavior, psychology, nutrition, and instrument design evaluated researchers-made questionnaire. To ensure the clarity of the questionnaire, a pilot examination was performed with 30 workers. The questionnaire was then modified based on the feedback received.

Perceived severity was measured with 12 items. The 2 week test/retest reliability of the perceived severity scale was $r = 0.89$ and the alpha coefficient (α) was 0.83. Perceived vulnerability was measured with 7 items. The reliability of the perceived vulnerability scale was $r = 0.71$ and the (α) was 0.78. Self-efficacy was assessed by 8 items. The reliability of the self-efficacy scale was $r = 0.77$ and the (α) was 0.90. Response efficacy was measured with 8 items. The reliability of the response efficacy was $r = 0.78$ and the (α) was 0.83. Intention to consume vitamins E and C was measured with one item asking participants about their intention during the next months. The reliability of the intention scale was $r = 0.69$ and the (α) was 0.88. These PMT constructs were assessed using a 5-point Likert scale (from1 = strongly disagree to 5 = strongly agree). Workers' knowledge was assessed by 13 items, which measured their capabilities to understand information about risk factors and antioxidant vitamins ($\alpha = 0.83$). Possible responses were correct answers = 1 and incorrect or don't know answers = 0.

The vitamins E and C intake were measured using a Food Frequency Questionnaire (FFQ). The FFQ contained questions regarding a list of foods and a standard serving size for each commonly consumed by Iranians (Movahedi & Roosta, 2000; Mirmiran et al., 2010). Whereas Iranian Food Composition Table (FCT) is not comprehensive and complete, for some food items the United States Department of Agriculture Food Consumption Table (USDA)FCT[1] was used, too. Workers were asked to report their frequency of consumption of a given serving of each food during the previous year on a daily, weekly or monthly basis. Portion sizes of consumed foods were converted to grams by using household measures (Movahedi & Roosta, 2000). Daily vitamins E and C consumption for participants were computed by Nutritionist IV software which was designed for evaluation of Iranian foods. Results were expressed as milligrams of vitamins E and C per day (mg/day).

Intervention

The face-to-face intervention was composed of eight sessions (two sessions per week). Each session took 30-45 minutes and consisted of lectures with PowerPoint presentations, discussion, questions and answers, and the distribution of educational pamphlets and booklets. Education sessions focused primarily on increasing knowledge. Moreover, the sessions concentrated on changing the related beliefs of response efficacy, self-efficacy, perceived vulnerability and severity. Workers also received individual sessions (15-20 minutes each) to review their personal purposes and intentions as well as recognize strategies to overcome obstacles. The control group received no educational or

[1] United States Department of Agriculture, Agriculture of Research Service: Available from: http://www.nal.usda.gov/fnic/foodcomp/.

counseling sessions but did receive the educational pamphlets and booklets after the final questionnaires were administered. The timeline, intervention components, and methods of education are shown in Table 1.

FFQ questionnaire, knowledge and PMT constructs were assessed at baseline and two month post-intervention.

Statistical analysis

Data analyses were done using SPSS 24.0. Values were given in means and standard deviations. Kolmogorov-Smirnov test was used to evaluate the normality of the knowledge data as well as the constructs of PMT. Comparisons between intervention and control groups were done through two-tailed unpaired t-tests and ANCOVA. To compare each group with itself before and after intervention, we used two-tailed paired t-tests. Descriptive statistics were used to describe the demographic characteristics. A probability level of 5% was considered statistically significant.

Research ethics

All workers provided written, informed consent and participation was voluntary. All procedures performed in this study involving human participants were in accordance with the ethical standards of the Kurdistan University of Medical Sciences ethics board (IR.MUK.REC.1395.70) and with the Helsinki declaration and its later amendments or comparable ethical standards.

Results

Demographic characteristics are displayed in Table 2. There were no significant differences between intervention and control groups for demographic characteristics.

Table 3 shows the mean vitamins E and C and PMT constructs scores before and after intervention. Results showed that there were no significant differences between the intervention and control groups at baseline. There were significant differences between the two groups on PMT constructs, knowledge and vitamins E and C consumption after education, considering the pre-intervention values as a confounding. Significant changes on PMT constructs, knowledge and vitamins E and C consumption were observed in the intervention group after education ($p < 0.001$). With regards to vitamin E, participants consumed an average of 0.88 mg of vitamins E on the day before intervention; after education participants reported consuming an average of 2.46 mg of vitamins E on the day in intervention group. This represents a significant increase in vitamin E consumption between the two time points. This increase was also observed for vitamin C. At baseline, workers reported an average of 10.07 mg of vitamin C on the day; after intervention workers consumed an average of 18.56 mg of vitamins C on the day in intervention group. Significant changes on PMT constructs, knowledge and vitamins E and C consumption were not observed in the control group after education.

Discussion

Our findings demonstrated that the implementation of intervention based on PMT among cement factory workers is an effective tool to increase vitamins consumption in this target sample. The employment of behavioral theory can increase the effectiveness of a dietary change intervention by providing information on which variables influence a particular behavior (Naghashpour et al., 2014). Moreover, Face-to-face individual and group discussion in this study, increased workers' perception of the seriousness of the threat condition, while exchanging experimental experiences and knowledge. As previous research supported, more effective results are produced from face-to-face education on the proper behavioral changes (Mahram, Mahram & Mousavinasab, 2009; Moonaghi et al., 2012). Zhang and Coock observed that after the intervention using PMT, there was a significant increase in vegetables and fruits consumption among undergraduates (Zhang & Cooke, 2012).

Although the present study found that vitamins E and C consumption increased generally, the mean amount of them at post-intervention was still much lower than the minimum recommended levels (15 mg/day for vitamin E and 90 mg/day for vitamin C) (Earl, 2004). It is possible that the intervention time period of 2 month was not long enough to bring about more changes in worker's motivation and behavior. Long-term follow-up studies are needed to determine whether maintenance of vitamins consumption can be achieved over the longer term. Health-related behavioral changes must be maintain and follow up to become a habit. Furthermore, investigation into what other factors such as cultural norms beliefs and socioeconomic characteristics that might influence vitamins consumption and food habits is warranted.

The PMT intervention in current study was effective at changing copping appraisals. On the other hand, self-efficacy and response efficacy in this study, were one of the effective mechanisms of vitamins E and C consumption behavior change in workers. The coping appraisal included of the person's expectancy that carrying out the recommendations can remove the threat (Dowd et al., 2016). PMT's coping appraisal components of self-efficacy and response efficacy showed positive significant associations with outcome measures related to behavior (Cox, Koster & Russell, 2004). Workers who are adequately informed on the benefits to be derived from regular antioxidants consumption such as reducing metals toxicity and preventing cancers and disease will reinforce behavior and attitude towards increasing the consumption of vitamins. Within the contingent of time, belief and socioeconomic status, if the participating workers believe they can successfully perform the recommended preventive behavior; such individuals will not hesitate to execute it. Sainsbury et al reported that coping appraisal to improve gluten-free consumption, increased after short-term intervention, using PMT (Sainsbury, Mullan & Sharpe, 2013). As coping appraisal had a higher impact on behavior than other PMT constructs, as reported in previous studies (McKinley, 2009;

Plotnikoff et al., 2014), specific attention should be paid to it when designing intervention plans.

Most of the workers in this study reported the low levels of perceived severity and vulnerability at baseline. This represents that the workers did not consider themselves susceptible to developing metal exposure threats and did not believe that threats would significantly affect their lives. Findings showed that workers had higher threat appraisal at post education. The threat appraisal depends on the person's estimate of the severity of the threat conditions and the chance of contracting the threats (Daniel, Enoma & Omobude-Idiado, 2014). Cognition is imperative in this context. Workers who have a good knowledge on the health implication of toxic metals in relation to cancers and diseases will adopt suitable behavior to prevent its occurrence by taking preventive behaviors such as healthy eating and promoting antioxidants consumption. Naghashpour et al., indicated that the three months educational intervention to improve calcium intake, significantly increased threat appraisal of students (Naghashpour et al., 2014). As other reviews of PMT-related research works, found that increases in threat appraisals lead to higher protection behaviors performance (Calder, Davidson & Ho, 2011; Floyd, Prentice‐Dunn & Rogers, 2000), these interventions could be emphasized.

This study showed that workers' knowledge of the effects of antioxidant vitamins on reducing metals toxicity was very low. Attention to research among workers exposed to toxic metals without sufficient knowledge has been less investigated and needs more attention. In this study, the mean score of knowledge after the intervention was significantly higher than that before. In other words, the nutritional education intervention based on PMT was successfully promote workers' knowledge and beliefs conducive to improving or maintaining positive dietary practices for prevention of harmful effects of toxic metals and cancers. Previous results suggested that increasing knowledge is effective at improving healthy eating behaviors (Sainsbury, Mullan & Sharpe, 2013; Miller & Cassady, 2012). Thus, it is important to conduct further interventions to investigate the relationships between knowledge changes and behavior.

The results of the present study indicated that PMT can be applied to vitamins consumption related behavioral intentions. Findings showed that workers had a greater intention to consume vitamins E and C after education. Intention increased an average of 1.71 between two points of time assessment in face-to-face intervention group. Intention is the result of coping appraisal and threat appraisal, and is a mediating construct that arouses and maintains protective health behavior (Daniel, Enoma & Omobude-Idiado, 2014). Good intention is more likely to be turn into action when people plan, how to carry out the desirable behaviors. Previous research showed that the behavioral intention was generally regarded as the strong predictor and the most vital determinant of the behavior (Rimer, Glanz & Rasband, 2001; Cox, Evans & Lease, 2008). Therefore, it should be considered in educational programs to improve health behaviors.

A number of possible limitations with the present study need to be addressed. This study relied on self-reported PMT and FFQ questionnaire, which introduces the biased outcome possibility. Furthermore, we did not have access to blood samples to increase the accuracy of assessment for dietary vitamins. The present study only had an assessment time after education. Although it is encouraging that significant effects on behavior and PMT variables were found over this time period, a longer-term study may have produced further findings. Despite these limitations, there are some novel points that should be noted. This is the first nutrition–intervention study to examine vitamins E and C consumption behavior using PMT among cement factory workers. Moreover, the vitamins consumption behavior was measured by objective tool.

Conclusions

In conclusion, the PMT model was found to be a reliable theoretical framework for improving vitamins E and C consumption. This result provide further support for the utility of the PMT as a framework for such intervention plans among this population of worksite in this health domain. Additionally, face-to-face intervention was shown to be effective in terms of increasing knowledge, PMT constructs, and vitamins consumption.

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Conflict of Interest:

The authors declare that they have no competing interests.

Authors' Contributions:

SMN participated in the writing and design of the study, performed the statistical analysis and drafted the manuscript. PT participated in the writing, design of the study and statistical analysis, helped to draft the manuscript, and read the paper critically for theoretical content and interpretation of study findings. BS participated in editing and helped to draft the manuscript. MSH participated in the preparing the manuscript.

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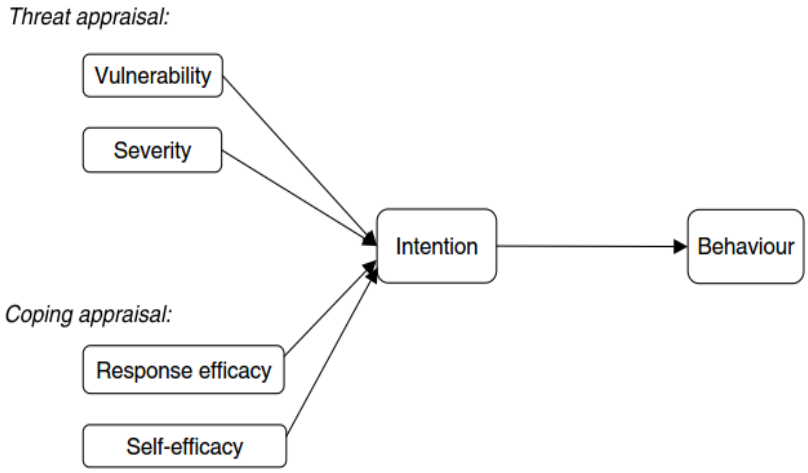

Fig. 1. Protection Motivation Theory

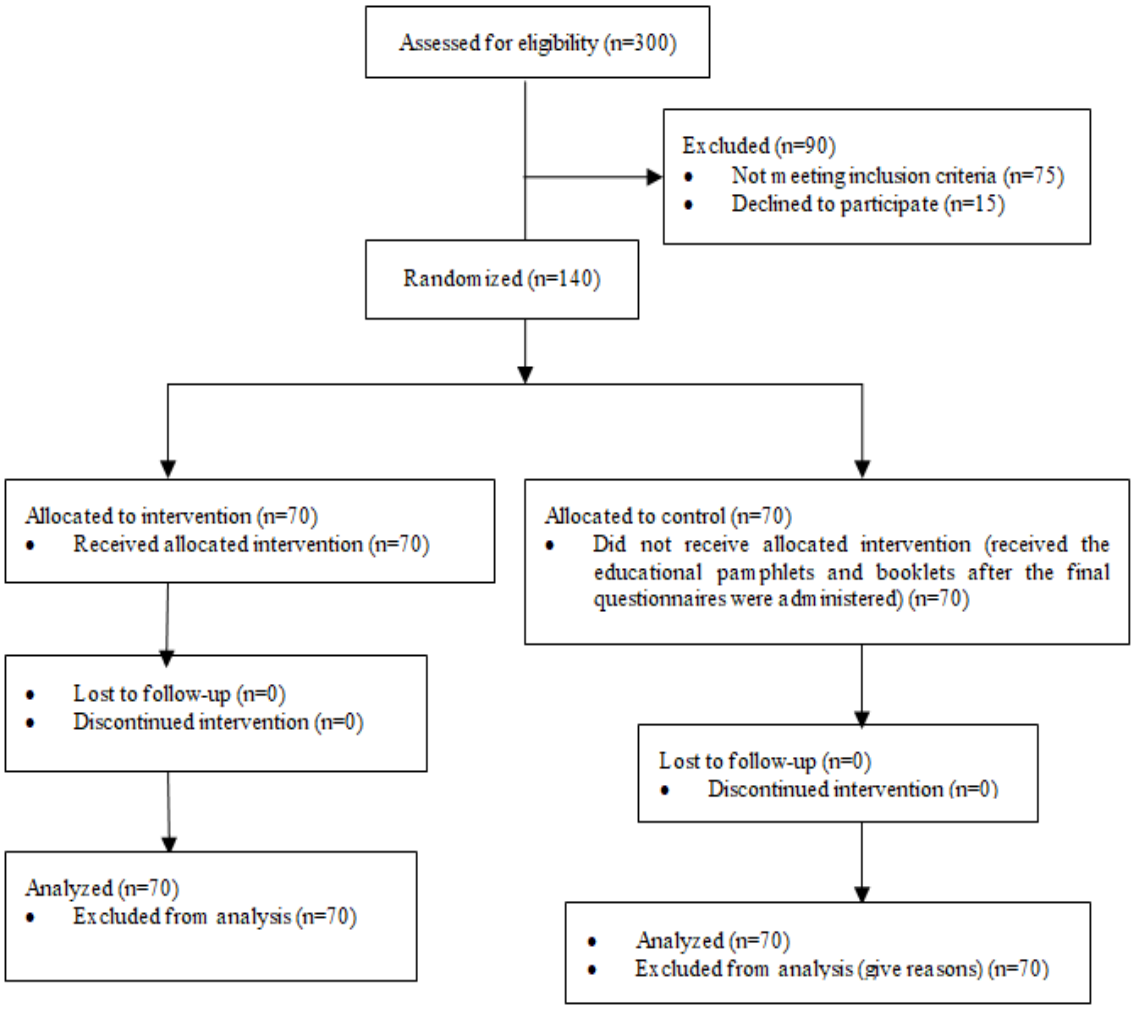

Fig. 2. Protocol of the intervention study

Table 1: Components of interventions by time, targeted constructs, and methods.

Time	Theoretical constructs	Methods used
Week 1 and 2	Knowledge	Group session components: - Lecture about the effects of vitamins E and C on reducing metals toxicity, introduce vitamins-rich foods, effects of toxic metals. - Power point presentation and distribution of educational booklets on the benefits of vitamins E and C.
Week 3 and 4	Perceived severity and vulnerability	Group session components: - Lecture about the effects of vitamins deficiency, highlighting the seriousness of the threat condition like heavy costs of disease treatment, increasing individual's perception of the threat of toxic metals exposure - Distribution of educational pamphlets on the effects of toxic metals
Week 5 and 6	self-efficacy	Group session components: - Lectures about the participants' ability to overcome obstacles to consume healthy diets, highlighting the importance role of vitamins E and C. - Group discussion about how to consume vitamins in diet. Individual session components: Individual-tailored counseling about workers' knowledge of healthy diet
Week 7 and 8	Response-efficacy	Group session components: - Lectures about the more emphasis on the role of vitamins in decreasing the risk of diseases, necessity of testing vitamins. -Question and answer about the materials presented in the past sessions. Individual session components: Individual-tailored counseling about workers' vitamins consumption.

Table 2: Demographic characteristics of the workers in groups.

Demographic characteristics	Intervention	Control	*p*-value
Age (year), Mean (SD)	34.60 (4.50)	34.69 (4.78)	0.48
Working experience (year), Mean (SD)	9.21 (4.52)	8.09 (4.27)	0.24
Education, Number (%)			
Under diploma	4 (5.71)	3 (4.29)	0.67
Diploma	29 (41.43)	30 (42.86)	
Bachelor science	25 (35.71)	25 (35.75)	
Master science	12 (17.14)	12 (17.18)	
Marital status, Number (%)			
Married	52 (74.29)	53 (75.71)	0.48
Single	18 (25.71)	17 (24.29)	

SD: Standard Deviation.

Table 3: Changes in variables before and after intervention.

Variable	Group	Before education	After education
Vitamin E (mg/day)	Intervention	0.88 (0.38)^{aA}	2.64 (0.80)^{aB}
	Control	0.87 (0.40)^{aA}	0.88 (0.39)^{bA}
Vitamin C (mg/day)	Intervention	10.07 (5.44)^{aA}	18.56 (8.70)^{aB}
	Control	9.54 (4.96)^{aA}	9.74 (4.73)^{bA}
Knowledge	Intervention	1.34 (0.20)^{aA}	2.65 (0.29)^{aB}
	Control	1.38 (0.29)^{aA}	1.41 (0.28)^{bA}
Self-efficacy	Intervention	2.47 (0.39)^{aA}	3.22 (0.27)^{aB}
	Control	2.46 (0.39)^{aA}	2.52 (0.40)^{bA}
Response efficacy	Intervention	3.00 (0.52)^{aA}	3.89 (0.35)^{aB}
	Control	3.07 (0.45)^{aA}	3.09 (0.45)^{bA}
Perceived severity	Intervention	2.96 (0.51)^{aA}	3.54 (0.37)^{aB}
	Control	2.93 (0.50)^{aA}	2.96 (0.51)^{bA}
Perceived vulnerability	Intervention	2.46 (0.49)^{aA}	3.50 (0.30)^{aB}
	Control	2.47 (0.50)^{aA}	2.50 (0.49)^{bA}
Intention	Intervention	1.59 (0.50)^{aA}	3.31 (0.69)^{aB}
	Control	1.60 (0.49)^{aA}	1.64 (0.48)^{bA}

Means reported and standard deviations in brackets.

$^{A, B}$ Means with the same letter in row (different times) are not significantly different.

$^{a, b}$ Means with the same letter in column (different groups) for each variable are not significantly different.