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The acute effect of an exercise program combined with psychological self-regulation strategies on smoking delay

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Abstract

Exercise has been proposed as a treatment method for smoking. The purpose of this study was to examine the acute effect of a moderate intensity exercise session combined with psychological techniques on smoking behavior among smokers. In particular, the purpose of this study was to investigate the effects of an acute bout of moderate aerobic exercise on smoking urge and smoking delay. Participants were 11 adults, non physically active, smokers. They all participated in two moderate intensity exercise conditions; one of them included self-regulatory strategies, and a control condition. Results indicated that 30 minutes of moderate intensity exercise combined with self-regulatory strategies (goal setting, breathing and self-talk) reduce smoking desire and delay smoking for 32 minutes. Additionally 30 minutes of moderate intensity exercise delay smoking for 29 minutes. Findings supported previous research that acute exercise reduces cravings to smoke. The role of psychological self-regulation strategies is proved to be crucial according to the results, but this topic should be further and more in depth investigated because of the lack of previous evidence.

Key words: smoking delay, craving, moderate exercise, psychological self-regulation strategies

Contents

Introduction

Physical activity

Physical activity has been described as a healthy behavior that reduces conducts of mortality mischievousness, while improving quality of life among individuals (DeRuiter & Faulkner, 2006;Paffenbarger, Hyde, Wing, & Hsieh, 1986)**.** Research regarding the benefits of exercise on health, concluded that both physical and mental health benefit from exercising (Landers & Arent,2007). From a physical health perspective, it has been supported that exercise decreases the incidence of heart attacks and the risk of cardiovascular disease, strengthens the muscular and skeletal systems, facilitates the reduction of body fat, improves the functioning of the immune system, such as blood flow regulation, and decreases the risk of several types of cancer as well as diabetes type-2 (Dishman, Heath &Washburn, 2004). From a psychological health perspective, exercise has been found to reduce symptoms of anxiety (Gorman, 2002) and depression (Faulkner & Taylor, 2005; Petruzzello, et al., 1991; Theodorakis, 2010), increase self-esteem and self-confidence (Calfas & Taylor, 1994; Ekeland, et al., 2004; Fox, 2000; Gruber, 1986; McDonald & Hodgdon, 1991), lead to more positive mood (Gauvin & Brawley, 1993; Lazarus, 1991), and help cognitive functioning (Colcombe & Kramer, 2003; Cotman, & Engesser-Cesar, 2002).

In summary, physical activity works as one of the healthiest and most natural medicine approaches to avoid, prevent and treat health issues. In recent years, physical activity has been employed as a major treatment for patients facing health issues related to obesity, smoking, and alcoholism (Khan, et al., 2012; Lee, et al., 2012).

Smoking

Smoking has been recognized as an unhealthy behavior that increases mortality risks and causes a variety of health problems (Peto et al., 2010). A considerable amount of studies has identified smoking as the main contributor in health diseases, such as different types of cancer, cardiovascular problems, hypertension, osteoporosis and others (Akiba & Hirayama, 1990; Doll et al., 1994; Giao, et al., 1991; Krall & Dawson-Hughes, 1991; LaVecchia et al., 1991; Mazess & Barden, 1991; Slemenda et al., 1989). Despite the fact that smoking is such a harmful habit, the rates of young people smoking raises rapidly (Copeland,Shope & Waller, 1996; Roosmalen & McDaniel, 1989).

Given the rates of smokers and the risk of mortality caused by smoking, a major question comes up: "Why do people smoke?". According to Lujic, Reuter and Netter (2005) many factors like peer influence, social environment and psychosocial issues make people smoking addicts. Additionally, based on the same study, lack of self-confidence, self-esteem and need for happiness turn smoking addiction into an antidote for self and social approval and psychological "high- stable" situation. Moreover, Theodorakis (2010) stressed out that not only personal, social and psychological factors lead people to become smoking addicts, but also neurobiological ones, through the release of chemical substances in the circulatory system while smoking. This procedure works as a booster of emotions and reactions, such as euphoria or relaxations, while it increases the need for further nicotine ,thus making smokers more and more addicted to nicotine and increasing the difficulty of quitting smoking. Summarizing the above, the initiation of smoking behavior can be attributed to a wide variety of factors that turns smoking addiction into a behavior that could not be changed easily.

Physical activity and smoking

The detrimental effects of smoking on health have eventually led to the development of programs aiming to help smokers quit smoking. Considering that physical activity is a healthy activity that improves physical and mental health, and has been related to the adoption of other health-related behaviours (such as proper diet), whereas smoking is an unhealthy habit with detrimental health effects, which has been related to other unhealthy behaviours (such as consumption of alcohol), physical activity is among the strategies that have been employed to help smoking cessation among smokers. Considerable research has been conducted in different conditions and populations in order to investigate whether or not exercise and physical activity could effectively aid smoking cessation. Ussher et al., (2000, 2005) in their review on exercise and smoking studies suggested that there is not strong evidence on exercise having a positive effect on smoking cessation, whereas DeRuiter and Faulkner (2006) pointed out a positive correlation between physical activity and smoking cessation. Overall, even though there is no robust evidence and no clear explanation on how physical activity affect smokers, physical activity is progressively becoming an important feature of intervention aiming at reducing or quitting smoking (Theodorakis, Gioti and Zourbanos, 2005).

Consequently, there is a need to further investigate the reason and the meaning of physical activity as a treatment for smoking, with particular emphasis on the features and the characteristics of such programs to enhance the effectiveness of physical activity interventions on smoking cessation. Summing up the above it could be stated that both smoking and exercise are related with mental issues (Landers & Arent ,2007; Lujic, Reuter & Netter , 2005). On the physical activity domain, psychological strategies, such as goal setting, self-talk, imagery, relaxation and others have been widely used to regulate behaviour, facilitate learning, and enhance

performance. Such strategies has also been shown to help individuals maintain or improve their mental and physical health (Murphy & Tammen, 1998; Thelwell, Greenlees & Weston, 2006). In addition, many smoking cessation programs use consultation and psychological support to help smokers cope with smoking problems (Ussher, 2005). Therefore, the use of psychological self-regulation strategies could potentially help towards the goal of smoking cessation through the adoption of exercise behaviour. The purpose of this study was to investigate experimentally whether the use of psychological self-regulation strategies during aerobic exercise could affect smoking behaviour.

Literature Review

Exercise and Smoking

Even though smoking is one of the most crucial factors that lead to early death, attempts to quit smoking have success around 3-5% and most smokers relapse after 8 days of abstinence (Hughes et al., 1992; Hughes et al., 2004). Different ways have been tested in order to help smokers quit smoking such as pharmacological treatments and nicotine substitute. Pharmacological therapies seem to have a low rate of success- less than 30% of smoking cessation- while nicotine replacement therapy (NRT) increases smoking abstinence by a 15% (Jorenby et al. 1999; Silagy et al. 2004). Motivational interviewing, behavioral support based cessations and counseling have been used in order to promote new ways of reducing smoking (Colby et al., 1998; Dunn, Deroo & Rivara, 2001; Orleans et al., 1991; Zhu et al., 1996).

Moreover physical activity on its own or combined with counseling and behavioral support has been tested as a main factor on smoking cessation (Theodorakis, Gioti, Zourbanos, 2005). Based on research findings, people who are physically active tend to smoke less (Theodoarakis & Hassandara, 2005; Thorlindsson, Vilhalmsson & Valgeirsson, 1990) and have less potential of becoming smoker than the sedentary population (McGovern, Rodriguez & Moss, 2003). Additionally McDermott, Dobson and Owen (2009) in their research pointed out that participation in physical activities on a moderate to high level leads to abstinence of smoking and avoid smoking relapse on former smokers. Summing up increase on physical activity is positively correlated with decrease on smoking.

Physical activity as a treatment method for smoking

Researchers since 1980 have tried to highlight the relationship between exercise and smoking, digging into the common points of these behaviours and their

reciprocal interaction (Theodoarakis et al., 2008). Studies referring to this subject could be separated into two categories: long term intervention programs and investigations of acute effects; the former referring to long term effects of exercise on smoking behaviours, whereas the latter referring to immediate changes on smoking behaviour on completion of physical activity (Perez, 2009).

Interventions and exploration of acute exercise effects have been tested in different populations concluding in various results. Based on previous evidence, participation on exercise should affect mental-psychological aspects (Stathopoulou, et al., 2006; Taylor 2000; Taylor, & Faulkner, 2008). Marcus and colleagues (2005) gave evidence that among women, the boost of fitness leads to lower levels of depression. Thus, it is confirmed that exercise does affect mental health and there is a need to investigate its role as a quitting strategy. In addition concerning people with mental health issues, specialists have a tendency to choose exercise as a treatment strategy (Arbour-Nicitopoulos, et al., 2011b; Faulkner, et al., 2007). Characteristicly, research has supported the effectiveness of ecercise in reducing depression (Vickers, et al., 2009).

Another population of interest is inactive female populations (Barnes, 2007), and most studies have shown that exercise interventions for smoking abstinence that include female samples are less effective (Linke, et al., 2013). Women tend to experience mood instability as well as being more fragile than men, thus they use smoking as a mood regulation strategy in a higher percentage than men (Perkins, 2001; Reynoso, Susabda, & Cepeda-Benito, 2005). Moreover another issue that turns women into a “special” sample is weight gain; they are inclined towards the equivocal idea that smoking cessation and weight gained have positive bonding. Even though there are studies that have confirmed this statement, physical activity enrollment with the combination of a healthy diet, could work as efficient solution for weight

maintenance or weight lost, quitting smoking as well as the adoption of healthy lifestyle habits (Aubin, et al., 2012; Donelly, Smith, & Jacobsen, 2004; Farley et al., 2012; Parsons et al., 2009). Although women are skeptic regarding exercise and smoking abstinence, pregnant women prefer exercise as a treatment for not smoking during this vulnerable life cycle. They adopt physical intervention programs in order to quit smoking, to avoid weight gained as well as to avoid the use of nicotine substitutes (Pomerlau, Brouwer, & Jones, 2000; Ussher, & West, 2003; Ussher, West, & Hibbs, 2004). Summing up, exercise intervention programs could work for women because they reduce the threat of weight gained, regulate better mood disturbances and decrease smoking withdrawal symptoms and the craving of cigarettes (Linke et al., 2013).

Acute effects

The acute effects of short bouts of exercise have been widely examined. In general the different studies on this topic have followed similar structures and the results seem consistent. This literature will now be presented. In one of the early studies Pomerlau et al. (1987) examined the acute effects of exercise on plasma nicotine. Even if there was no significant difference on plasma nicotine after exercising, a significant reduction of smoking desire after 30 minutes of intense exercise was recorded**.** The authors highlighted that 3 out of 10 participants asked if it was obligatory to smoke after exercise because they didn't feel like smoking. This was one of the first notifications on how acute exercise affects smoking behaviours.

Some years later Thayer et al., (1993) investigated the effect of brisk walks on cigarette and sugar cospumption delay based on the assumption that moderate exercise increases energy feeling and leads to tension reduction. The findings confirmed their hypothesis that walking reduces the desire of smoking and increases

energy feelings. Although no tension reduction was noticed for the smokers after exercise probably because exercise couldn't overcome their tendency to smoke. More specifically participants exercisers (had a 5-min walk) reported lower urge to smoke compared with non-exercisers and had a net 8-minutes delay before smoking their next cigarette. Effects of brisk walks in smokers have also been investigated by Taylor and Katomeri (2006) in their study they found that 15 minutes brisk walks affect smokers' blood pressure. The findings for smokers were in line with previous studies regarding non-smokers, while resting blood-pressure and self-reported smoking cue-elicited cravings seemed to affect the results (Taylor, 2000). The findings of this research point out another positive acute effect of exercise for smokers.

In a similar study Ussher and colleagues (2001) examined the effects of moderate intensity exercise on a stationary cycle on smoking withdrawals and desire to smoke. Findings confirmed previous results by pointing out the acute effects of exercise on smoking desire; in the exercise condition participants scored lower than in control condition. While Ussher and colleagues (2001) compared 10 minutes of moderate exercise with two control conditions (passive waiting and video watching**),** Daniel and colleagues (2004) compared 5 minutes of moderate exercise with 5 minutes of light exercise and passive control condition, always regarding tobacco withdrawal symptoms and smoking desire. According to the findings 5 minutes of moderate exercise where more effective than light exercise and passive condition on changing smoking desire. However 10 minutes of moderate exercise seemed to be more effective than 5 minutes. Thus what should be further investigated is whether the duration of exercise is crucial for leading to changes on smoking behaviours.

Taylor, Katomeri and Ussher (2005) pointed out that previous studies were very well structured and controlled to avoid methodological risk factors. Based on the

principles of the self-determination theory, Taylor, Katomeri and Ussher let participants chose the intensity of a one mile walk. Results indicated that after a one mile self-paced walk, desire to smoke was reduced, with low intensity 20 minutes walk leading up to 20 minutes cigarette delay. These findings suggest that choice may be a major factor on cigarette delay; thus more research should be done in order to more in depth investigate how time and type of exercise influence smoking behaviours. A year later the same research team investigated the acute effects of exercise on smoking withdrawal symptoms and cravings. They argued that the absence of a theoretical framework explaining the relationship between exercise and smoking importantly limits the research potential. Mood and emotional changes that have been observed after exercise (Ussher et al, 2001; Daniel et al., 2004), should be examined in order to understand how affective responses to exercise influence smoking behaviours (Taylor, Katomeri, & Ussher, 2005). Therefore Taylor, Katomeri and Ussher (2006) ran their study by using two theoretical frameworks: Nesbitt's Paradox (Schachter, 1973) and the circumplex model of affect (Russell, 1980). Results indicated that one mile low-moderate intensity walk (participants chose the intensity on their own) leads to the reduction of smoking desire for at least 20 minutes after exercise. These findings were not aligned with Daniel and colleagues' research (2004) who pointed out that moderate intensity has better effects on smoking desire than low intensity exercise. Regarding these two theoretical frameworks, what was found is that tension was reduced during and after exercise, while there were not significant results for energy and vigor changes (Nesbitt's Paradox). Moreover this study confirmed previous findings (Ekkekakis et al., 2000) by pointing out the effects of walking in activation and balance; activation increases right after finishing physical activity, when balance seems to increase during and for more than 20 minutes post exercise (circumplex model). To sum up, these researchers stressed out the need of

examining affective response to exercise concerning smoking behaviors into a perspective of a theoretical framework, the need to provide higher standards of autonomy to the participants and finally the need to make clear the different results regarding the intensity of exercise.

Following their empirical work, Taylor, Ussher and Faulkner (2007) did a review in order to examine the acute effects of exercise on smoking withdrawal symptoms and cravings. Fourteen studies were included in their review and the results suggest that a single session of exercise affects smoking behaviors. More specifically 12 out of 14 studies compared an exercise condition with a control condition and confirmed the hypothesis that exercise does affect smoking withdrawal symptoms and cravings. Intensity and type of exercise varied from low to high in walking and cycling activities and isometric exercise. Nevertheless there is no evidence on which of these could be the best treatment for smoking cessation. The two studies that compared different intensities of exercise on smoking behaviors had many limitations (Everson, Daley, & Ussher, 2006; Pomelrau et al., 1987) and no comparison between different intensity levels could be done among these studies.

Another issue that came out of this review is whether and how distraction affects smoking craving. This was based on the evidence that the higher the intensity of exercise, the most cognitive demanding the situation is, this meaning that the participants get distracted from smoking by focusing on exercise (Ekkekakis, & Acevedo, 2006). However, moderate intensity cycling had significantly better results than a distraction task on cravings (Daniel, Cropley, & Fife-Schaw, 2006; Ussher et al., 2001). Thus Taylor and Katomeri (2007) pointed out that distraction is not a main contributor on smoking withdrawal symptoms and cravings.

Last but not least, findings of this review showed that exercise seemed to be a more effective way for coping with smoking addiction than response to glucose (West

et al., 1999) or Nicotine Replacement Therapy (NRT; West & Shiffman, 2001). Exercise (isometric or 1-mile walk) had better results than glucose or NRT when smoking desire was measured by the same scale (Daniel et al., 2004; Taylor, Katomeri, & Ussher, 2005; Ussher et al., 2006; West et al., 1999).

Van Rensburg and Taylor (2008) confirmed the results from Taylor and colleagues (2007) regarding exercise. A 15-minute brisk walk on an intensity chosen by the participants reduces cigarettes cravings. However their hypothesis that exercise would affect cognitive functioning was not confirmed. Although low intensity exercise affects smoking desire, it may not suppress all smoking related thoughts, while higher intensity keeps participants focused on somatic reactions than cognitive smoking thoughts (Avecado, & Ekkekakis, 2006). This could be a hypothesis on how exercise affects cigarette cravings and smoking behaviors. Therefore, future research should more in depth examine how different types of exercise influence cognitive functioning.

Ussher and his colleagues (2009) expanded the research regarding isometric exercise by examining the effects of isometric exercise and body scanning on smoking cravings and withdrawal symptoms. What was found, through pre and post measurement of smoking craving and withdrawal symptoms, was that in laboratory settings and normal environment, an experimental group had better results than a control group with a higher difference in the laboratory setting. Moreover smokers pointed out that such an intervention would be efficient for smokers who want to quit smoking. These findings were consistent with previous results who stressed out the effectiveness of relaxation techniques (body scan) and isometric exercise on smoking cravings (Cropley, Ussher, & Charitou, 2007; Ussher et al., 2006).

Taylor and colleagues (2007) in their review found four studies that investigated time to ad libitum smoking after exercise. All studies conformed that

time is increasing after small bouts of exercise, from at least 8 minutes until almost an hour (Katomeri & Taylor, 2006; Reeser, 1983; Taylor & Katomeri, 2007; Thayer et al., 1993). Mikhail (1983) and Reeser (1983) run two studies that were related on topographic measures, such as time and intensity of puffs, after exercise. Results showed that exercise delays smoking and puffs intensity but more studies should be done in order to confirm these findings. Therefore Faulkner, Arbour-Nicitopoulos and Hsin (2010) ran a research looking for the acute effect of exercise on smoking behaviour (puff time after exercise). The results confirmed that low-moderate intensity of exercise does reduce cravings in contrast with passive conditions. Moreover the smoking scenery does change after brisk walk with participants delaying the first puff and having smaller puffs with lower volume. However in comparison with previous research, participants were asked to smoke right after the end of exercises while it's more common to let participants chose when they wanted to smoke. This was done in order to have a clearer view on the smoking structure. This study adds evidence on the contribution of physical activity as an effort to change smoking behaviours.

Two more reviews about smoking and exercise have been done since 2012; one by Roberts and colleagues (2012) and the other by Haasova and colleagues (2012). They both examined the acute effect of exercise on smoking withdrawal symptoms and cravings. Both reviews had similar results and confirmed the beneficial role of physical activity on changing smoking behaviors. What was found is a negative correlation among cravings and different types of exercise; Elibero and colleagues (2011) indicated that both yoga practice and moderate intensity walking in a treadmill are better predictors on smoking withdrawal symptoms than passive condition, and isometric exercise has the same effects (Ussher et al., 2009), while resistance exercise was no significant correlated with cravings (Ho, 2009).

Nevertheless there is no clear evidence after both meta-analysis on which type and intensity of exercise leads to better results. Only two studies showed no significant differences between exercise and control group regarding desire to smoke (Everson et al., 2006; Ussher et al., 2006), in Roberts and colleagues research, while in Haasova and colleagues meta-analysis a larger affect was noticed when the comparisons among the studies was narrowed down to only moderate intensity exercise and control conditions.

Both studies stressed out that age and nicotine dependence could affect results; with that being said participants that were older seemed to have higher effect size and generally the highest the baseline scores were the highest the effect would be (Katomeri, 2009; Taylor, Katomeri, & Ussher, 2005; Ussher et al., 2001). Moreover Everson and colleagues (2006) run a study in adolescents (16-19 years old) by using moderate exercise and the results were not in line with the ones regarding adults (Daniel, et al., 2004). Therefore future studies should examine how age affects cravings and withdrawal symptoms through physical activity.

Last but not least Taylor and colleagues (2007) in their review about cravings proposed a possible mechanism regarding cravings affect factors, such as stress reduction and activation, biological factors (β-endorphins, cortisol, or opioids) and cognitive factor such as distractions. Roberts and colleagues confirmed these mechanisms. According to them, affect factors that should be examined as possible mechanism should be related to how mood could be a mediating factor on exercise-craving relationship and also how intensity of exercise affects exercise-craving relationship (Elibero et al., 2011). Moreover apart from the biological factors that were proposed in previous research, nicotine metabolism should be examined. Smoking behaviors were found to change because of nicotine metabolism (Lerman, et al., 2006; Schnoll, et al. 2009), therefore nicotine metabolic ratio should be examined.

Until now distraction was thought to be the major cognitive contributor, but Harper (2011) brought up the roles of outcome expectancies and credibility as moderate factors. However there is no clear evidence on if and how they work, thus their role should be further examined. Summarizing the literature regarding the effects of acute bouts of exercise on smoking behaviour, the results quite consistently suggest that exercise reduce desire to smoke and increase the delay of smoking.

Long term intervention programs

Many long-term intervention programs have been implemented promoting physical activity as an aid for smoking cessation with the structure and results varying throughout the years. Two of the early studies were conducted in 1988 concerning exercise intervention as an aid for smoking behaviour change (Russell et al., 1988; Taylor et al. 1988). Taylor and colleagues found no significant differences among control and exercise groups, while Russell and colleagues suggested that exercise could maintain smoking abstinence among smokers following acute myocardial infarction (AMI).

Nevertheless, later studies confirmed that exercise intervention programs may facilitate smoking cessation (Marcus et al. 1991; Marcus et al., 1999; Marcus et al., 2003a; Martin, Kalfas, & Patten, 1997). In all, Marcus and colleagues' research intervention started before quitting smoking and participants exercised under the supervision of a consultant; therefore supervised exercise was proposed as a main contributor of smoking cessation. Moreover Martin, Kalfas and Patten (1997) not only compared exercise to a control group but also with nicotine replacement treatment (NRT). Exercisers had better results in a less than 6-weeks intervention program; in contrast no significant results were found regarding NRT. Prapavessis (2004) in his research stated that nicotine replacement strategies combined with exercise have

better results than exercise on its own. Many studies have brought up that exercise wasn't confirmed as a predictor on smoking abstinence during the intervention or later, during follow-ups. However, results for exercise group were closer to the initial hypothesis than the control group (Ciccolo et al., 2011; Hill, Rigdin, & Johnson, 1993; Kinnunen et al., 2008; Marcus et al., 2005; Prapavessis et al., 2007).

Ussher and his colleagues (2000) ran a meta-analysis of the interventions that were implemented from 1980 to 1999 examining the effects of exercise on smoking (Ussher, Taylor, West, & McEwen, 2000). Eight studies were found fitting their research criteria. Only two of them confirmed the hypothesis that exercise intervention programs affect smoking abstinence (Marcus et al., 1999; Martin, Kalfas, & Patten, 1997), with one of them showing positive results on smoking abstinence after a year follow-up (Marcus et al., 1999). What was suggested after this review was that intervention programs should be well-structured, with larger samples. Moreover physical activity in long-term intervention should be examined also from another perspective; not the one that improves physical health, but the one that is combined with self-efficacy, self-confidence and self-esteem (Fox, 1998). Ussher and his colleagues (Ussher et al., 2005; 2008; 2012) ran reviews with the results being in line with previous research. Only Marcus and colleagues (1999) provided tree times per week supervision to the participants on vigorous intensity exercise, combined with cognitive behavioural strategies. This approach stood up for exercise intervention programs being beneficial for smoking abstinence even a year later. The common element in these reviews was that the time the intervention should start before or at the same day with the quitting day; in other words smokers should cope with more than one change simultaneously, smoking cessation and the adoption of a physical active lifestyle (Emmons, et al., 1994; King, et al., 1996; Patten, et al., 2001).

Greece is among the countries with the highest percentage of smokers in Europe (WHO, 2009). Hassandra et al., (in press) implemented a physical activity program especially developed to assist smoking cessation, the "No more Smoking - Time for Exercise" program. The implementation of the program on 50 smokers yielded outcomes that show significant reductions on the amount of cigarettes they smoked after the intervention, an effect that was maintained a year after. Moreover, it was suggested that physical activity worked against weight gain and stress; thus physical activity could work as a coping strategy for those who smoke because they feel are afraid of gaining weight, or feeling stressed (Landers, 1994). The program helped smokers through self-regulation strategies and goal setting to replace unhealthy habits with healthy ones.

Studies promoting physical activity as an intervention strategy with large samples have been conducted through the internet. Oenema, Brug, Dijkstra, deWeerdt, & deVries (2008) conducted a study to examine the effect of a computer based intervention on fat intake, participation in physical activity and smoking dropout. More than 2000 people participated in this study and the results indicated that the intervention was beneficial for reducing fat intake and increasing physical activity. Nevertheless, no significant results were found regarding smoking; this is probably because of the difficulty to increase exercise and decrease fat intake and smoking simultaneously. McKay and colleagues (2008) highlighted the fact that a web-based intervention, which stress out behavioural self-management has the same impact with a web-based exercise intervention program that only promotes participation in physical activity without providing any further coping strategies. Moreover participants according to evidence took part in moderate or vigorous intensity exercise after 6-months follow up.

Overall, research examining the effectiveness of exercise interventions on smoking behaviour has not being conclusive. Thus, preparatory research is warranted to identify elements or features related to exercise that can help improving the effectiveness of such programs for smoking cessation. Among such elements, investigating the use of psychological self-regulation strategies may be of particular importance, since such strategies have been shown to influence cognition, affect, and behaviour.

Psychological skills

Based on what was mention until now regarding the effectiveness of acute bouts of exercise and intervention programs on smoking cessation, delay or abstinence, psychological and mental factors seem of particular importance for achieving and maintaining smoking abstinence. Ward (2001) in his attempt to investigate how nicotine replacement therapy (NRT) work for smoking proposed psychological insights as a co-strategy of nicotine substitutes. This idea came out on the findings of psychologists who developed theories regarding behavior change. More specifically Ward mentioned that people follow specific steps in order to change behavior and they decide to choose the ones that fit best on their abilities and capabilities. This was confirmed by Bandura's self-efficacy theory (1977) who suggested that people participate in activities in which they feel confident to engage to, so as to lead in a behavioral change; therefore their self-efficacy and self-confidence would increase. Ward (2001) came out with the result that an NRT program combined with psychological techniques could reach a rate of effectiveness regarding smoking cravings at a point of 32% after six and twelve months follow-ups. Summing up psychological insights seemed to be beneficial.

Psychological techniques have been widely used in other domains such as sports. Gould, Flett and Bean (2009) proposed that mental training is not just a way to enhance performance but a whole procedure that affects self-perception aspects, self-confidence, self-esteem, and self-efficacy, self-awareness, self-regulation, anxiety, depression, concentration issues, controlling actions and emotions, enhancing well-being and promoting positive mood. A crucial question at that point should be what a mental training intervention includes. The answer is that the key point for developing mental health is learning to use the psychological techniques, such as goal setting, self-talk, relaxation techniques, imagery, breathing and others (Vealley, 2005). All these techniques have differences and similarities and have been in depth studied in sport domain developing more than desirable attitudes (Vealley, 2007). At this point the three psychological techniques, self-talk, goal setting and breathing, that will be used in this research will be further analyzed.

Self-talk

People do always talk to themselves, everyday every moment. These internal dialogues of people were the early steps for examining and developing the psychological skill of self-talk. Self- talk has passed through different definition, however the most common and used is the one by Hardy (2006). He described self – talk as: "*(a) verbalizations or statements addressed to the self; (b) multidimensional in nature; (c) having interpretive elements association with the content of statements employed; (d) is somewhat dynamic; and (e) serving at least two functions, instructional and motivational, for the athlete" (p.84).* Self –talk could be distinguished in motivational and instructional, positive and negative. Instructional self-talk involves statements that relate to attention focus, technical information, and tactical choices, while motivational self-talk refers to statements that relate to confidence building, effort input, and positive moods (Zinsser, Bunker, & Williams,

2001). Positive self-talk was subdivided on psych-up, confidence, instruction and anxiety control when negative self-talk involved worry, disengagement, and somatic fatigue (Zourbanos et al. 2009). It has been widely used in sport domain, elite and non-elite athletes with results indicating that as a mental strategy it could enhance performance, increase concentration, maintain confidence, increase self-esteem and self-efficacy and reduce stress (Theodorakis, Hatzigeorgiadis, & Zourbanos, 2012). Self-talk has not been examined in depth in the physical activity domain but there is evidence of the beneficial effects on increasing participation in moderate exercise level in colleague students(Gammage, Hardy & Hall, 2001). Based in Vygotski's (1962) assumption that self-talk could be used as a self-regulatory strategy, it was widely examined in other domains such as physical activity, children with learning difficulties and learning disabilities, with the results being in line with the initial hypothesis of the beneficial role of self-talk on negative thought replacement, self-regulation and performance enhancement (Theodorakis, Hatzigeorgiadis, & Zourbanos, 2012; Zourbanos, 2013). Self-talk is an ideal strategy for participation and improvement of exercise, but also works as a cognitive strategy for improving ones self-esteem, self-efficacy, self-confidence, self-reinforcement, concentration, relaxation, anxiety, depression, emotional disorders (Beck & Emery, 1985; Conroy & Metzler, 2004; Hardy, Gammage, & Hall, 2001; Landin & Hebert, 1999; Mallett & Hanrahan, 1997; Zinsser, Bunker, & Williams, 2001).

Goal setting

Setting personal goals is also used from people in different situations and environments. Goal setting seemed to have positive effect on industry and sport environments (Weinberg, 2009) through enhancing performance, helping athletes to gain control of their actions, self-regulate, self-direct and self-evaluate (Browne, & Mahoney, 1984). Goals could be distinguished in outcome goals, meaning winning or

losing, performance goals, run 1500m in 4 minutes; and process goals, focusing on the whole procedure to achieve a performance goal (Burton, Naylor, & Holliday, 2001; Weinberg, 2009). However just setting goals in general does not guarantee a positive effect, while goal setting works as a motivational self-regulatory strategy that is crucial for commitment, concentration, increase of effort and development of strategies for problem solving and goal achievement (Locke, & Latham, 1990). According to Poag and McAuley (1992) setting goals could work as a motivational strategy in order to lead people into participation in physical activity. This was confirmed later in a review of studies examining how goal setting affects exercise and sport (Kyllo, & Landers, 1995) indicated that realistic and specific goals, either short-term or long term do affect performance. Another issue that came out from this review based on Bandura's theory (1977) is that level of difficulty of the goals should be adapted so as to promote self-efficacy. Consequently, goals should be set in terms of task's difficulty and personal abilities. Last but not least Shilts, Horowitz and Townsend (2004) in their review stressed that an intervention program that includes goal setting strategy could help to behavioral change and more specifically goal setting supports the adoption of a physical active lifestyle and a healthy diet.

Breathing

If people use self-talk and goal setting spontaneously during everyday life what they use the most is breathing as a survival function. One of the most sounded finding factor about breathing is how breathing exercises can be used as a treatment or mental strategy; it has been used in relaxation techniques or part of multidimensional mental training for athletes (Vealey, 2007). Willingly controlling the breathing is possible to bring alterations in the autonomic responses. Two different types of breathing are used and further studies should be done in order to evaluate their effect

on different parameters (Mourya et al., 2009). According to evidence, on the one hand slow breathing is believed to decrease the basal heart rate, heart rate response to standing (Pal, Velkumary, & Madan, 2004) and blood pressure (Rosenthal et al., 2001) leads to better oxygenation as well as improving exercise performance (Bernardi et al., 2001). On the other hand fast breathing is likely to increase the blood pressure and the heart rate, and enhance sympathetic drive to the myocardium (Narkiewicz et al., 2006).

Yoga sessions that include breathing as a main strategy have been used among athletes for the achievement of self-awareness, stress control and self-confidence enhancement (Ryba & Kaltenborn, 2006). Moreover breathing was used as a strategy for coping with addictive substances as part of a whole section in order to reduce craving, withdrawal symptoms, anxiety, depression and stress (Chen et al., 2010). Moreover breathing exercise combined with specific exercise programs, such as walking, seemed to have beneficial effects on diabetes mellitus (a psychosomatic disorder), hypertension, obesity and depression (Mourya et al., 2009; Tiwari, et al., 2012).

There is evidence that breathing alone or while being part of yoga sessions could be a crucial factor for reducing smoking withdrawal symptoms, cravings and negative affect (Dai, & Sharma, 2014; McClernon, Westman, & Rose, 2004). The effects on abstaining smokers were aligned with active smokers based on Shahab, Sarkar and West (2013) research. By the time yoga and breathing have been confirmed as a way to promote mental health, through enhancement of well-being and positive mood and reduction of anxiety (Mehta, & Sharma, 2010,;McCaul, Solomon, & Holmes,1979; Sharma, Gupta, & Bijlani, 2008), physical health and behavior change, such as smoking or other addictive substances quitting (Bock et al., 2011; Khaana, & Greeson, 2013; McIver, O' Halloran, & McGartland, 2004), seemed to be

a promising psychological technique for different interventions for behavioral change (Dai, & Sharma, 2014; Nespor, & Prokes, 2005).

Concerning what was said about these techniques until now it's obvious that there is no strong evidence on how they work in exercise, contrary with sport domain and how they affect smoking. Nevertheless few studies about breathing and smoking have shown some promising results (Dai, & Sharma, 2014; Mehta, & Sharma, 2010; Sharma, Gupta, & Bijlani, 2008). Ushher and colleagues (2005, 2008) mentioned that goal setting was used combined with counseling in long-term intervention does affect smoking cravings. Gilbert (2010) was the one who suggested self-talk as a strategy for smoking reducing into self-compassion intervention. Therefore there is much more field to be covered from sport psychologists so as to reach the understanding of the mechanisms that make psychological techniques combined with exercise promising connecting points for achieving and maintaining smoking abstinence.

Purpose- Importance of the study

The current study aimed to examine the acute effect of a moderate intensity exercise session combined with psychological techniques on smoking behaviour among smokers. In particular, the purpose of this study was to investigate the effects of an acute bout of moderate aerobic exercise on smoking urge and smoking delay.

Exercise has been proposed as an aid for smoking cessation; two explanations have been mostly forwarded to explain such effects: neurobiological mechanism and cognitive distraction. While exercising, dopamine levels are increased which enhances mood and causes euphoria. The same symptoms are caused when nicotine enters into the smokers' organisms and activate brain centers (Cosgrove, Huner, & Caroll, 2004; Taylor, Katomeri, & Ussher, 2004; Taylor, Ussher, & Faulkner, 2007). Cognitive distraction could be an antecedent for reducing stress and anxiety that are the main

factors that lead smokers to lighten up a cigarette (Morgan, 1997). However there are doubts about the second explanation (Daniel, Cropley, & Fife-Schaw, 2006). Acute and long-term intervention programs based on exercise have given some evidence on the role of physical activity as a coping strategy. Regarding smoking and other addictions, indicators of addiction are indeed behavioral in contrast with the development and dependence of addiction that are processes, cognitive, emotional and psychological (Scioli et al., 2009). Moreover counseling, cognitive strategies and psychological techniques have been used in smoking cessation programs, as mentioned throughout the whole literature review. There is not clear evidence on how psychological techniques could benefit an exercised-based program regarding smoking cessation on the exercise itself and on smoking behavior changes. Therefore, this study will further examine the effects of exercise, and will additionally test the potentially crucial role of psychological self-regulation strategies, on smoking behaviour.

Hypothesis

Two hypotheses were formed. First, that an acute bout of moderate aerobic exercise will will increase smoking delay. Second, that the adoption of psychological self-regulation strategies while exercising will further this effects; i.e. using self-regulation strategies will result in greater smoking delay.

Method

Participants

After an ethical approval from the University Research Ethics Committee was granted, smokers were recruited through public advertisements. Thirteen individuals started the experimental condition but two failed to meet the scheduled appointments. Thus, participants were 11 adults (5 males, 6 females) with a mean age of 47.18 (±9.38) years, mean weight 76.06 (± 15.43) kg; and mean height 1.69 (± 0.10) m. Participants were physically inactive (as assessed through the International Physical Activity Questionnaire-short form; IPAQ, www.ipaq.ki.se).

Procedure

A repeated measures design was adopted including three conditions: control, plain exercise, exercise complemented by self-regulation techniques. All sessions were scheduled for the morning and participants were asked to abstain from smoking overnight. A one-week interval was allowed between the three sessions. Upon arrival for the first session participants were explained the procedures and were asked to rest for 5 minutes to measure their resting heart rate. Anthropometric measures were subsequently obtained and a a questionnaire assessing exercise and smoking behaviour was completed. Before the application of the each treatment exhale CO levels were measured, to ensure that participants had not smoked for the last 8 hours. Finally smoking urge was assessed.

Control condition

In control condition participants were asked to watch a video for 30 minutes (5 different types of documentaries to choose) during which they would not be allowed to smoke. Every 5 minutes the researcher checked the heart rate of the participant and every 10 minutes smoking urge was assessed. After 30 minutes they were informed that they would stay in the lab for another for 30 minutes, during which they would

continue watching the video, however they were now allowed to smoke whenever they felt like. From that point time until smoking was recorded.

Plain exercise condition

For the plain exercise condition participants were asked to cycle in moderate intensity (55% of heart rate reserve) for 30 minutes, on a cycle ergometer (Monark874E, Sweden). They were asked to cycle at a rate of 55-60 revolutions per minute. Heart rate was monitored and resistance was regulated so that the desired heart rate was maintained. Heart rate, revolutions per minute, resistance, and perceived exertion were recorded every five minutes, whereas smoking urge was assessed every ten minutes. While cycling participants could watch one of the available documentaries on a screen placed in front of them. Upon completion of the exercise protocol participants informed that they would stay in the lab for another for 30 minutes during which they could continue watching the video, and that they were allowed to smoke whenever they felt like. From that point time until smoking was recorded.

Exercise and self-regulation condition (exercise SR)

In the exercise and self-regulation condition 2 participants followed the same protocol as in the plain exercise condition In addition, they were introduced into the use of three self-regulation techniques. Researcher provided verbal information and instruction about goal setting, self-talk and relaxation breathing. Researcher and participant practiced together how to breathe during exercising and were instructed to use this breathing technique whenever they felt like to relax. Then participant chose from a variety of suggested word or phrases the one that will be used during exercise to motivate themselves. Finally, regarding goal setting, the duration and the intensity of the cycling was in this occasion presented as a goal (rather than an instruction). The goal was to maintain 55-60 revolutions per minute for the 30 minutes they were about

to cycle. The same protocol was followed upon completion of the cycling task; in addition participants completed a questionnaire assessing their preference with regard to the two exercise protocols.

Measures

Exercise behaviour. It was measured with IPAQ (Craig et al,2003). It is a questionnaire that measures how many times and for how long people are active per week. It also measures different intensities of exercise (light, moderate and vigorous). It is a valid and reliable questionnaire that has been widely used as a measurement for exercise behavior in different research contexts.

Smoking behavior. It was measured with The Fagerström Test for Nicotine Dependence (Heatherton et al., 1991) questionnaire and by asking them how many cigarettes they smoke per day. This questionnaire that has been used and tested before, measures the number of cigarettes and under which circumstances participants smoke. Its validity and reliability have been tested.

Performance measures. Heart Rate (HR) was recorded using a Sports Tester PE 3000, Polar Electro, (Kempele, Finland). Rate of Perceived Exertion (RPE) was assessed using the Borg Scale. Power output in Watts (PO) was calculated based on revolutions per minute, distance per revolution in meters, and resistance in kilograms.

Smoking urge. Two items drawn from the Questionnaire of Smoking Urges-Brief (QSU-brief; Cox, Tiffany, & Christen, 2001) were used to assess smoking urge (e.g., I have an urge for a cigarette), before and every 10 minutes during exercise. These items were measured on a 7-point scales ranging from 1 (not at all) to 7 (very much).

Exercise preference. Participants' preference regarding the two exercise protocols was also assessed through a self-report instrument including 3 items that measured relative preference between the two exercise protocols (e.g., I like more the

exercise program…). These items were measured on a 7-point scale ranging from 3 (of my first exercise session) to 0 (equally), to 3 (of my second exercise session).

Use of psychological techniques. The actual use of the three self-regultion techniques was assessed through two items (do what degree did you make use of the recommended techniques) on a 10-pint scale (1=not at all, to 10= very much).

Results

Control measures for the three conditions

Participants reported smoking on average 22 (± 7.55) cigarettes per day and 18.63 (± 10.1) cigarettes for the previous day. The mean score for nicotine dependence was 4.27 (± 1.84). One-way repeated measures ANOVAs were calculated to test for differences in resting hear rate, exhale CO levels, and urge for smoking before the three conditions. The analyses showed no significant differences among the three conditions for all three variables ($p>.05$). Descriptive statistics are presented in Table 1.

Table 1

	Resting HR	CO Levels	Smoking Urge	Average HR
Control group	59.64 ± 3.12	10.10±1.38	4.32±.55	65.33±3.41
Exercise	61.273± 3.88	10.20±1.05	3.41±.61	126.92±2.74
Exercise with self-regulation	60.636± 4.07	8.50±1.14	3.00±.66	126.38±4.40

Control measures for the exercise conditions

One-way repeated measures ANOVA was calculated to test for differences in average heart rate among the three conditions (control, exercise and exercise SR). The analysis indicated a significant effect, $F(2, 9) = 348.23$, $p<.05$, partial $\eta^2=.99$. Examination of the pairwise comparisons showed significant differences between the control and the exercise condition 1 ($p<.05$), and between the control and the exercise condition 2 ($p<.05$). No significant differences were found between the two exercise conditions ($p>.05$). Descriptive statistics are presented in Table 1. Two paired sample t-test were executed in order to examine fatigue and power output between the

two exercise conditions. Regarding both variables no significant results were found (p>.05). Descriptive statistics are presented in Table 2.

Table2

	Average RPE	Average output
Exercise	14.34± 3.15	45.73±1.15
Exercise with self-regulation	13.86± 3.00	47.16±1.32

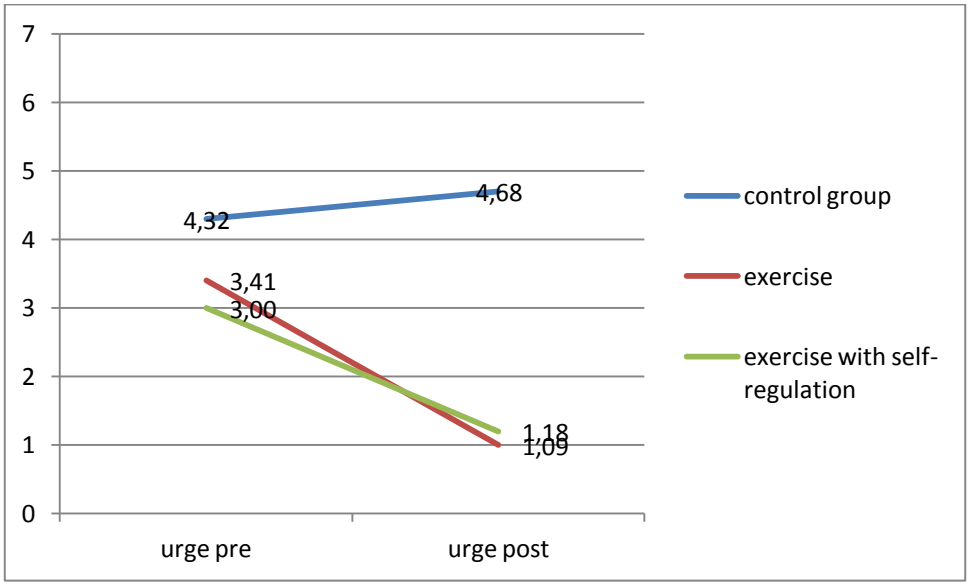
Smoking variables

A 2x3 repeated measures ANOVA was executed in order to examine differences in urge to smoke during the three conditions. The analysis indicated a significant effect, F (2,9)= 3.2, p<.05, *partial* η^2=.42. Examination of the pairwise comparisons showed no significant differences in urge to smoke before the three conditions, p>.05. Significant differences were found in smoking urge after experimental condition between the control and the exercise condition, and between the control and the exercise SR condition. No significant differences were found between the exercise and the exercise SR conditions. The pairwise comparisons for pre- and post-exercise urge for each condition revealed no significant differences for control condition (p>.05). In the exercise and exercise SR conditions there were significant decreases from pre- to post-exercise urge to smoke (p<.05). Descriptive statistics are presented in Table 3. Mean scores for smoking urge for the three conditions appear in Diagram 1.

Table 3

	Pre urge	Post urge
Control group	4.31±.55	4.68±.74
Exercise	3.41±.61	1.10±.09
Exercise with self-regulation	3.00±66	1.18±.12

Diagram 1



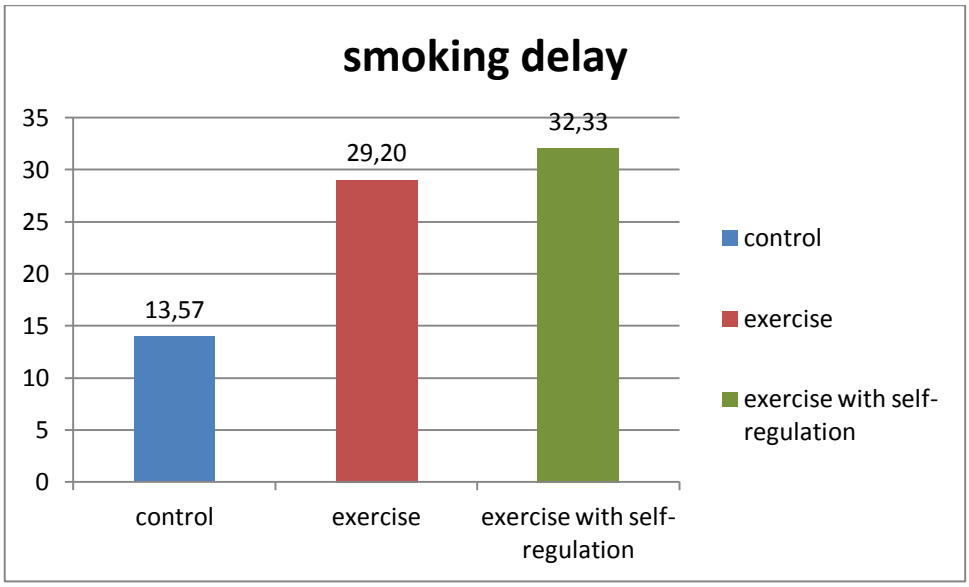
One-way ANOVA was calculated to test for differences in smoking delay between the three conditions (control, exercise1 and exercise 2). The analysis showed a significant effect, F (2, 9) = 5.03, p<.05, *partial* η^2= .53. Examination of the pairwise comparisons showed significant differences between the control and the exercise condition (p< .05), and between the control and the exercise SR condition (p<.05). In addition, an effect that approached statistical significance was observed between the exercise and the exercise SR conditions (p=.06). Descriptive statistics

are presented in Table 4. Mean scores for smoking delay for the three conditions appear in Diagram 2.

Table 4

	Smoking delay (minutes)
Control group	13.57±6.17
Exercise	29.20±7.11
Exercise with self-regulation	32.33±7.5

Diagram 2



Preferences on exercise protocols

A one-sample t-test was calculated to test for the preference of participants regarding the two exercise protocols. Participants indicated a preference on exercise

with SR, $t(10)= 3.60$, $p<.05$, as they found it more helpful, they like it more and it is easier to be followed.

Use and help of psychological strategies

Participants reported making thorough use of breathing (mean, 7.45±1.75) and goal setting (mean, 8.18 ±1.66), but not so of self-talk (mean 5.50, ± 3.59). Furthermore, they reported breathing and goal setting as very helpful strategies (for breathing, mean 8.36 ± 1.50; for goal setting, mean 8.27 ± 1.42); whereas they did not rate self-talk as particularly helpful (mean 4.5 ± 3.56).

Discussion

Physical activity has been widely used as a possible "treatment" to smoking addiction, when psychological consultation, medicines, intervention programs have been widely applied in order to examine the mechanisms and the possible treatment for changing smoking behavior (Theodorakis, 2010). The results have indicated a negative relationship between smoking and exercising, suggesting that increases in exercise reduce smoking desire, or else that people who are physically active tend to smoke less than those not exercising (Roberts et al., 2012). Until now research has provided inconsistent results regarding the effectiveness of exercise as a means to quit smoking (Theodorakis, 2010). Moreover research on the effects of psychological skills, such as goal setting, imagery and breathing, on smoking cessation has not provided with robust support (Dai, and Sharma, 2014; McClernon, Westman and Rose, 2004; Oettingen, Mayer and Thrope, 2010; Ussher et al., 2003). Therefore, research is warranted to explore how exercise-based smoking cessation programs may become more effective.

In the present study the effects of exercise complemented by self-regulation strategies on smoking behaviour was investigated. In particular, the impact of an acute bout of aerobic exercise in combination with goal-setting, breathing, and self-talk, on smoking delay was examined. The initial purpose of the study was to support that psychological strategies combined with exercise delay smoking more compared to plain exercise and control conditions. The results indicated that there was a marginal, but meaningful, effect for smoking delay between the two exercise conditions (10% delay), which justifies a cautious interpretation of the results.

The current study came up with the conclusion that 30 minutes of moderate intensity of exercise (cycling more specifically) could delay smoking for at least 29 minutes compared with a passive condition (video watching). A careful look in the

relevant literature suggests that smoking delay following acute exercise depends on the duration and intensity of exercise. In particular, it has been shown that a 5 minute walk reduces smoking desire and subsequently delays smoking for 8 minutes (Thayer et al., 1993), while15 minutes of walking could reduce smoking desire and delay first puff according to research (Theodorakis, 2010). In the same line 5 minutes of moderate exercise are more effective than 5 minutes of light exercise, or than a passive control condition, but 10 minutes of moderate exercise seemed to be more efficient than 5 (Daniel et al., 2004). Moreover 20 minutes of moderate exercise delays smoking for at least 20 minutes (Taylor, Katomeri and Ussher, 2005). A recent meta-analysis stressed out the crucial issue that a larger affect was noticed when the comparisons among the studies was narrowed down to only moderate intensity exercise and control conditions (Haasova et al., 2012).

Apart from duration and intensity of exercise another crucial issue is the type of exercise. Cycling and walking have been widely used on interventions and experimental condition regarding smoking (Ussher et al., 2003). Elibero and colleagues (2011) through their research introduced other types of exercise. They suggested that both yoga practice and moderate intensity walking on a treadmill were better predictors on smoking withdrawal symptoms than passive conditions and isometric exercise, especially when it's is applied in laboratory conditions (Ussher et al., 2009), while resistance exercise was not related to cravings (Ho, 2009).

Age, sex and years of addiction in smoking seemed to be some others factors that do affect smoking delay after exercise (Katomeri, 2009; Taylor, Katomeri, & Ussher, 2005; Ussher et al., 2001). For example Everson and colleagues (2006) run a study in adolescents (16-19 years old) by using moderate exercise and the results regarding cravings and withdrawal symptoms were not in line with the ones regarding adults (Daniel, et al., 2004). In our study, age and gender were not examined as

moderating variables, however, it is evident that the effectiveness of exercise as a means for smoking cessation is affected by many other factors that should be considered when designing intervention programs.

Our findings also suggest that the use of psychological self-regulation techniques further enhanced smoking delay. Among the strategies used, goal setting and breathing were identified by participants as mostly helpful. However, the interpretation of these results should be cautious due to the marginal effect. The lack or relevant previous evidence further enhances the need for further research to support the present findings, and identify what are the mechanisms explaining such effects. Cross and Marcus (1991) stressed out that in order to achieve a behavioral change (e.g. smoking delay, adaption of healthy lifestyle, stress control) self regulatory strategies could be used as facilitators that lead to a desirable behavior, a desirable new self. Psychological skills such as imagery and self-talk have been previously proposed as predictors for developing and increasing self-regulation regarding smoking addiction (Kelly, Zuroff and Foa, 2010). Moreover Murru and Martin (2010) suggested that imagery that focuses on fear of the feature without exercise compared with positive effect of a life with exercise, influences self-efficacy and self-regulation. Activation of feared or hoped-for health-related possible selves has been tested by Hoyle and Sherrill as a mediator that leads to self-regulation. The results indicated that when feared-for health-related selves are being activated self-regulation increases, while Oyserman and James (2008) proposed that it is not the fear or the hope of another self that leads to self-regulation but the need to change the present-self into another one that leads to increase of motivation and adaption of self regulatory strategies.

Based on the aforementioned what could be suggested regarding the findings of this study is that the psychological techniques had a better impact on smoking

delay because they helped participants to better regulate themselves and to be committed to a specific goal. Research has supported the effectiveness of psychological skills training on the self-regulation of behavior (McCrory, Cobley and Marchant, 2013; Zimmerman, 2000). Furthermore, self-regulation could be the key for understanding addiction and implementing effective interventions, as addictive behavious cannot be internally regulate (West, 2006).

Summing up, exercise was confirmed as an aid for smoking delay, while goal setting, breathing and self-talk, and in particular the two former, helped participants to enhance self-regulation for coping with physical activity and control smoking. It is important to mention that once a self-regulatory strategy is used in one task, for one's thoughts, emotions or attention control, then this compromises self-control in other tasks in every aspect of life (Muraven, Tice, and Baumeister, 1998). Thus, the effect of the psychological strategies used for the realization and completion of exercise, during the course of the exercising, may have helped prolonging the resistance to smoking.

Future studies

As a next step to this research, a trial with a larger sample would help verifying these preliminary findings and support with greater confidence the effectiveness of exercise and the added value of self-regulation strategies in delaying smoking, and thus in designing smoking cessation intervention programs. The intensity of exercise is another potential issue. In this study a moderate intensity was selected, however, so far there is no clear evidence regarding the most appropriate intensity of exercise in relation to smoking delay (Roberts, et al., 2012). Thus, it would be interesting to examine whether vigorous exercise or exercise at chosen intensity would have a greater impact on smoking behaviour. Moreover, as this research pointed out the role of psychological techniques in delaying smoking, future

studies should investigate the potential mechanisms though which psychological skills work in relation to smoking delay. In addition, exploring the mechanisms through which such techniques may influence behaviour change for addictive behaviors would greatly enhance our understanding of the facilitating effects of exercise and self-regulation in and facilitate the development of effective intervention for smoking cessation. Finally, the assessment of physiological and neurological variables in combination with psychological variables in exercise interventions would greatly advance knowledge regarding the role of exercise for smoking cessation.

Conclusion

Physical activity and psychological skills training have been widely used as means for behaviour change in different contexts, and have proven effective. The purpose of this study was to test whether the addition of psychological self-regulation strategies would have an added impact on the effect of exercise on smoking delay. The results are encouraging, suggesting that indeed the use of goal-setting, breathing and self-talk were a useful addition to the exercise protocol. More studies are warranted to enhance our confidence regarding these findings, but also to test additional self-regulation techniques. Nevertheless, the present investigation enhances our understanding and provides valuable evidence for the development of exercise-based interventions aiming at smoking cessation.

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