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THE EFFECTS OF SMOKING ON THE HEALTH AND SLEEP OF SPORTSWOMEN

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ABSTRACT

This survey studied the health and sleeping patterns of 92 physical education and sports science students highly involved in sport. A strong correlation was found between smoking and various complaints of ill health as well as between smoking and sleep duration and quality of sleep. The results suggest that there is a strong relationship between the constituents of tobacco smoke and poor sleeping habits.

INTRODUCTION

Within the last 20 years, the percentage of the population who continue to smoke has decreased greatly, mainly due to research into disease causation and probability of disease occurrence, in relation to smoking and the chemical substances produced by the combustion of tobacco. The most well known diseases which have been linked with smoking are lung cancer, chronic bronchitis, ischaemic heart disease and peripheral vascular conditions. However, although these effects have been greatly studied, other side effects or direct effects which are not fatal and which are not recognised as being so important have had far less research directed towards them. Hence, the importance of these effects is probably not recognised by the majority of the population.

The aim of this survey was to examine the effects of smoking on patterns of sleep, particularly sleep duration and quality of sleep. Palmer, Harrison and Hiorns (1980) carried out a similar investigation using questionnaires, to investigate the association between smoking, drinking and sleep duration for men and women. It was anticipated that the number of physical education and sports science students in this investigation who smoke would be lower than the incidence of smokers from more sedentary occupations. This is because health and fitness is associated with those people who are involved with high levels of training and participation in physical activity.

REVIEW OF LITERATURE

Jouvet (1974, 1974a) and other research workers (Hartmann, 1974; Koella, 1974) have demonstrated that

there are two monoaminergic systems which are important in the regulation of sleep. These are the serotonergic system largely found in the nuclei of Raphe and the catecholaminergic system which develops in the sulcus limitans of Hiss and locus coeruleus. This second system mainly consists of the noradrenergic system. Research into the biochemical mechanisms of sleep have been difficult as the monoamines themselves do not cross the mammalian blood-brain barrier. However, the use of precursors of these substances do cross this barrier and studies using them suggest that the role of the serotonin system is in inducing sleep and that the noradrenalin and acetylcholine systems regulate sleep and bring about wakefulness.

In 1976 Burn demonstrated that when nicotine is injected into the ventricles of the brain of a cat it causes a fall in blood pressure which he claims is the result of a release of acetylcholine due to the presence of nicotine. Burn also suggests that nicotine increases the rate of release of noradrenaline and on injecting nicotine into the ventricle of the brain he obtained an EEG which indicated arousal or wakefulness.

Experiments by Armitage and Hall (1967) also showed that nicotine releases acetylcholine in the brain of a cat bringing about arousal. Similar effects were obtained in experiments by Hauser et al (quoted by Warburton, 1975). They studied human subjects who smoked heavily. Warburton suggests that nicotine not only causes the release of acetylcholine but also acts upon the noradrenalin and serotonin systems.

Dunn (1976) claims that nicotine has two effects

on these neurotransmitters. Firstly it can affect some cholinergic receptors by causing depolarisation and so stimulates the action of acetylcholine. The second type of effect is to cause the release of noradrenalin and serotonin.

Nicotine when absorbed after smoking therefore affects various areas of the brain, including the sleep-waking cycle. These effects may be aided by adrenergic mechanisms or possibly by carbon monoxide levels in the blood which are also increased by smoking.

In "Smoking and Health Now" published by the Royal College of Physicians (1971), they suggest that nicotine is able to mimic the action of acetylcholine and noradrenalin by stimulating the transmission of nerve impulses. Its specific effect depends upon the dose or level of nicotine absorbed. Small doses or low levels of nicotine stimulate the cholinergic neurons whereas large doses or high levels paralyse these neurons (Royal College of Physicians Publication, 1977).

In their recent study of the lifestyles and health of 725 men and 759 women, Palmer et al (1980) included data on the effects of drinking and smoking on sleep duration and sleep quality. They obtained a negative relationship between cigarette smoking and sleep duration for both men and women. However, they did not find any association between smoking and quality of sleep. The mean sleep duration for their non-smokers was 7.50 hours for females and 7.30 hours for males. The mean sleep duration for exclusive cigarette smokers was 7.33 hours for females and 7.00 hours for males.

A similar study carried out by Dr. C. R. Soldato (1980), at the University of Pennsylvania sleep research and treatment centre, investigated two groups consisting of 50 smokers and of 50 non-smokers. He found that smokers took longer to get to sleep than non-smokers and that they were more likely to wake up during the night. He also found that the sleep of the smokers improved when they stopped smoking.

METHOD

In order to compare directly the findings of the present study with those presented by Palmer et al (1980) copies of their "General Health" and "Life Style" questionnaires were obtained. From these, forty questions were extracted of which a few were modified to apply more to college students. The questions included topics such as general health, smoking and drinking habits, life style and questions relating to sleep.

All first and second year specialist female physical education students and all the first year female BSc sports science students at Brighton Polytechnic were asked to complete the questionnaire. Only women students were contacted because the number of men

students available was small. All the women were between the ages of 18 and 23 years. The age range was kept small in order to eliminate any effects of age. Hence correlation coefficients for age were not calculated.

Questionnaires were distributed to 63 first year students and 69 second year students. Of these 132, 92 (67%) were returned — 46 from first years and 41 from second year students (59%). Five questionnaires were completed but there was no indication from which year group they came. The replies to the questionnaire were grouped according to whether the subjects were smokers or non-smokers. Chi-square techniques and t-tests were used to analyse the answers to the individual questions. Only P values less than 0.05 were regarded as significant.

Of the 92 students who completed the questionnaire, 22 students smoked, of which approximately half were second year students. Twenty students smoked between 1-20 cigarettes per day and two students smoked 21-30 cigarettes per day. All these students smoked cigarettes and 2 students also smoked cigars; 70 students (76%) were classified as non-smokers.

RESULTS AND DISCUSSION

Of the 40 questions answered, answers given by the smokers were significantly different to those given by the non-smokers in sixteen questions. These differences are presented in Tables I, II and III.

The first significant results are concerned with general health and drinking habits (Table I). They can be explained in two different ways. Firstly that smoking and possibly drinking are the cause of these health problems. Thus for example, the smokers in this study suffer from a greater incidence of tension headaches than non-smokers, due to a reduction in the supply of oxygen to the brain. It is well known that haemoglobin has a greater affinity for carbon monoxide than for oxygen. Smokers have higher levels of carbon monoxide in their blood than non-smokers. O'Donnell et al (1971) for example, demonstrated that 15% of the haemoglobin of smokers is in the form of carboxyhaemoglobin. This reduction of available oxygen in the blood of smokers may increase their respiratory rate and blood circulation, resulting in an increased blood pressure which in turn could cause headaches. At times of greater tension or stress the heart rate and blood pressure rise which may also cause headaches.

An alternative view is that those people with a greater number of health problems such as tension headaches smoke to try to relax themselves. This explanation would also account for the significantly higher incidence of nervous problems, worrying and unhappiness reported by the smokers.

TABLE I
(Chi-square 1 d.f.)

Questions Asked	Positive answer given Smokers %	Non- smokers %	Level of signifi- cance
Has a doctor ever said you had tension headaches?	22.7	7.1	.05
Has a doctor ever said you had back injury or disease	40.9	7.1	.001
Have you been bothered by repeated pain or pressure in your chest when angry or excited?	9.1	0	.01
In the past six months, have you often been bothered by nerves?	36.4	7.1	.001
Do you have worrying thoughts that keep returning?	41.0	17.1	.05
Have you often felt depressed and unhappy?	51.1	11.4	.001
Do you often have, without obvious cause — bladder complaints	13.6	1.4	.02
menstrual difficulties	41.0	15.7	.02
In the past six months have you lost more than 3 kgs (7 lbs) not due to dieting?	36.4	11.4	.01
Have you been taking unprescribed Medicines regularly — Aspirin or similar pain relieving tablets?	27.3	1.4	.001
— vitamin pills	27.3	8.6	.05
— other tablets	9.1	0	.02
Do you drink alcohol often?	86.4	34.3	.001
Do you drink large quantities of alcohol per occasion?	31.8	2.9	.001

The greater number of bladder complaints reported by the smokers can also be attributed to smoking. One effect of nicotine is to stimulate the hypothalamus to release ADH — antidiuretic hormone (Burn, 1976). This causes a retention of fluid due to a reduction in the excretion of urine which may in turn cause bladder complaints due to irregular urination.

A higher incidence of menstrual problems was also reported by the smokers. These menstrual difficulties covered a wide range of complaints, one of the most common of which was the occurrence of cramp especially in the abdomen particularly in the girls who had a heavier blood loss. The association between smoking and menstrual problems may be related to the level of carbon monoxide in the blood. The higher values of carbon monoxide present in the smokers' blood, by reducing the volume of oxygen available, could cause an increase in lactic acid in the muscles as opposed to pyruvic acid, leading to cramp.

Loss of weight which was not attributed to dieting was greater in the smoker's group. Indeed some of the students believed that smoking aids weight loss and they used it as an excuse for not giving up smoking. Smoking may have the effect of "dulling" one's appetite by perhaps decreasing in some way mechanisms which bring about the sensation of hunger. However, there is little empirical evidence to support this view. Another explanation for the finding may be that when smokers feel hungry or "peckish" they are more likely to light another cigarette rather than find themselves something to eat.

The results concerning types of tablets taken are also related to the general health problems. People, for example, who suffer headaches often take aspirin or similar pain relief tablets. Thus the frequency of taking analgesics is higher in the smokers' group, who also reported more headaches, bladder problems and menstrual difficulties.

The greater incidence of drinking alcohol in the smokers' group suggests that smokers tend to lead a wider social life or at least socialise on more occasions. Smoking and alcohol are often associated together in advertising and in the cinema for example. Usually, where alcohol can be bought and consumed, the availability of cigarettes is not far away. The dryness of the mouth and throat caused by cigarettes may also encourage smokers to drink more often and in greater quantities. If this were the case, it might be expected that smokers would also drink more cups of tea or coffee when alcohol was not available. However, this evidence was not demonstrated in the present survey.

As Table II indicates, the students who smoke were absent more often from college due to illness. This finding may also be explained by the greater incidence of health problems. However, a much more detailed analysis investigating the reasons for each absence away from college would need to be made before any definite conclusion could be drawn.

Tables II and III present several significant findings related to sleeping habits. Smokers go to bed later and take longer to get to sleep. The increased catecholamine levels in the brain of smokers which brings about arousal or a state of wakefulness may cause the smoker not to feel "sleepy" and remain awake for longer periods than non-smokers. As Armitage and Hall (1967), Burn (1976), Dunn (1976) and Warburton (1975) comment, nicotine stimulates the release of acetylcholine which causes wakefulness. They also suggest that nicotine brings about the release of noradrenalin which suppresses sleep and enables the wakeful state to be maintained.

The smokers in this study have a shorter sleep dura-

TABLE II
(t-test d.f. = 90)

	Group	Mean Score	Standard Deviation	Standard Error	Value of t	Two-tail probability
Number of times absent from college due to illness	A	1.955	1.939	0.413	2.355	20.05
	B	0.866	1.565	0.187		
Usual time going to bed (mins. from previous midday)	A	692.05	37.12	7.91	3.88	20.01
	B	654.43	47.03	5.62		
Time trying to get to sleep (mins. from previous midday)	A	697.5	45.77	9.76	2.395	20.02
	B	670.57	46.71	5.58		
Usual hours sleep per night on weekdays (hours/mins.)	A	7 h 22 m	56.84	12.12	-3.69	20.01
	B	8 h 14 m	56.34	6.73		

Group A = Smokers

Group B = Non-smokers

TABLE III

Reasons for waking up at night	Smokers %	Non-smokers %
Nervous tension or worries	31.82	21.43
Shortness of breath, coughing	18.18	10.00
Aches or pains	22.73	10.00
Hungry or thirsty	31.82	14.29
Dreams or nightmares	54.54	18.57

tion than non-smokers. This finding can also be explained by the suppressive effect upon sleep by neurotransmitters such as adrenaline and noradrenaline.

One of the major differences between smokers and non-smokers was the greater occurrence of dreams or nightmares and poorer quality sleep reported by the smokers. Neurotransmitters suppress REM (rapid eye movement) sleep and it is during this state of sleep that dreaming occurs. If the sleep of the smokers was disrupted during REM sleep therefore, this would explain why they awaken during dreams and nightmares. It is not that they awaken because of the dream, but that when they awaken they are more able to recall its occurrence.

The results of this survey compare favourably with those of Palmer et al (1980). The mean hours of sleep obtained by female exclusive cigarette smokers in the Palmer study was 7.33 hours compared to 7.50 hours for female non-smokers. In the present study it was 7.38 and 8.23 hours respectively suggesting an even greater relationship between smoking and sleep duration. This survey also supports the finding obtained by Soldato (1980) that smoking affects the quality of sleep as well as sleep duration.

To summarise: the smokers in the present study reported a higher incidence of minor health problems; they drink more alcohol, are more often absent from

college, take longer to get to sleep, sleep less and sleep badly. These findings are particularly important to the health of students who are involved in a concentrated sports programme and are prone to sports injury.

It is during sleep that the effects of fatigue are reduced. Butter (1968) suggests that smokers who attain less sleep will not have their fatigue effects reduced to that degree achieved by non-smokers. If this level of fatigue slowly but gradually builds up, concentration in performance will decrease. It is when levels of concentration are low that accidents occur often causing injury, a view supported by the present findings. The number of back injuries, for example, was significantly higher amongst smokers than non-smokers (Table I). Hartmann (1974) claims that it is during sleep that learning and memory are consolidated and when the mechanisms of energy and self-confidence are restored. Could the poor sleeping habits of the smokers in this study therefore explain why they have a greater tendency to be troubled by nervous worries and feelings of unhappiness?

Abilities which are most important to the sports involved person are fast reactions, quick decisions and a high level of co-ordination and control of movement, indeed the entire neurological mechanisms which lie behind the ability to learn to perform motor skills. To discover how these mechanisms are affected by smoking would require much more research. However, the findings of this study suggest that smoking may decrease performance in many ways, far more than have at present been studied. It further suggests that sport-involved people should not smoke. By doing so they appear more prone to injury occurring from a lack of concentration, which itself may be due to poor sleep habits caused directly by nicotine and carbon monoxide on the neurotransmitters of the brain.

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