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Effect of smoking on cardiorespiratory fitness among college students of Bankura

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Abstract: *Background*: Tobacco especially cigarette, smoking is a major risk factor for cardiovascular disease (CVD), such as stroke and ischemic heart disease. According to the World Health Organization that 10% of all deaths due to CVD are attributed to smoking. Basic ingredients of tobacco, causes an increase the risk of oxidative stress, impair the vascular endothelial function and activate the sympathetic nervous system. These associated with significantly higher serum concentrations of total cholesterol, triglycerides and lower levels of HDL. Smoking may leads to impairment in physical fitness. We have observed the effects of smoking on cardiorespiratory fitness stratified by body mass index (BMI) in the college students and also hypothesized that smoking may lead to decreased physical fitness despite a good level of physical activity in daily life. *Objectives*: The main objective of this study was to assess the effect of smoking on cardio-respiratory fitness and physical performances of an individual. *Methods*: This was a cross sectional study, 50 smoker (Group-I), 50 non-smoker (Group-II) college students were used. Each subject's age, smoking habits, the duration of smoking, health conditions were recorded. Anthropometrics, body composition, BMI, BP, PFT and PFI testing were assessed. *Results:* Result shows that 32 people are smoking <10 cigarettes daily but only 2 persons smoke ≥20 cigarettes daily. SBP and DBP were more in smoker's College students. The respiratory rate of smoker's college students is higher than that of non-smoker. Smokers strength of the respiratory muscle is less than non-smoker as a result they have reduced vital capacity. *Conclusion:* Smoking increases the risk of virtually all CVD parameters, including that of the newly identified risk of paroxysmal tachycardia.

Keywords: Smoking, Cigarette, Tobacco, Oxidative Stress, Cardiovascular Disease.

Introduction

Lifestyle of an individual incorporates prototypes of culture, behavior and their personal habits such as physical activity, diet, smoking or alcoholism that have developed through the process of socialization. It develops through an importunate interaction with family and peers. Tobacco use remains a global health concern. Not only for elderly persons but also among the adult population and is the major cause of death [1-3].

Unfortunately, despite recent favorable trends in developed nations, more than 8 million people are expected to die every year by 2030 [4]. Smoking has been linked to countless illnesses, among them cancer, cardiovascular and respiratory diseases and is the single most preventable cause of death worldwide [5-6]. After smoking carbon monoxide levels increases in the blood and reduces the amount of oxygen absorbed into the body [7]. Cigarettes are a complex mixture of nicotine, polyaromatic hydrocarbons, phenols and nitrosamines, which are submicron-sized solid particles; other gaseous components like, carbon monoxide, hydrogen cyanide, and nitrogen oxides. When a cigarette is smoked, it creates more than 7,000 chemicals and out of them at least 70 known carcinogens [8].

People who smoke have decreased physical activity levels making them at higher risk for chronic diseases. Physical activity may facilitate smoking cessation in many different populations. Regular physical activity enhances prevention of diseases like hypertension, osteoporosis, diabetes, back pain, respiratory, musculoskeletal problems, metabolic and neurological disorders [9].

Many scientific study shows depression and anxiety can be reduced through regular physical exercise [10-11]. Regarding smoking, research has shown that it exacerbates the prevalence of various functional problems and leads to serious diseases. One-half of the deaths caused by smoking will occur in middle age (35 through 69 years), resulting in the loss of 20 to 25 years of normal life expectancy [12].

Smoking is associated both prognostically and aetiologically with numerous diseases of the respiratory system. Tobacco smoking is a major cause of an accelerated decline in ventilatory function and physical fitness. As most of the people take to smoking when they are young, it will be much informative to study the effects of smoking on lungs in the initial stages. There is a great wealth of scientific evidence demonstrating the detrimental health effects on smokers. Cardiovascular disease is the world's leading cause of death, killing over 17 million people a year; with nearly 80% of these deaths occurring in low and middle income countries [13-15].

Tobacco use and second hand smoke exposure are major causes of cardiovascular disease [16-17]. Even smokers who smoke less than five cigarettes a day have been shown to be at a greater risk of developing coronary heart disease [16]. Tobacco use kills 5.1 million people per year [18]. Another 600,000 non-smokers die from second-hand smoke exposure [19].

Smoking is one of the most important risk factors for future cardiovascular morbidity and a major cause of cardiovascular disease mortality. More than one in ten cardiovascular deaths worldwide is caused by smoking [20]. Cigarette smoking has long been known as a serious topic in public health and it has been increasing in many developing countries around the world [21-22]. Nicotine was being the responsible for addiction, increase of heart rate (HR), blood pressure (BP) [23] and double product (DP) [24] which are alterations associated with the increase of cardiac work in smokers [25].

Smoking either active or passive can cause cardiovascular disease via a series of interdependent processes, such as enhanced oxidative stress, haemodynamic and autonomic alterations, endothelial dysfunction, thrombosis, inflammation, hyper-lipidaemia, or other effects [26].

Smoking and physical inactivity are strongly related to a deterioration in overall health status and are among the most important modifiable risk factors for chronic disease and premature death [27-28]. Chronic smokers usually exhibit elevated myocardial work and reduced exercise capacity and thus, lower overall cardiovascular fitness [29-30]. The main focuses of this study are to investigate the effects of smoking on cardio-respiratory parameters and on physical fitness

Material and Methods

The present cross-sectional study was conducted at the Department of Physiology, Bankura Christian College, Bankura. A self-designed, close-ended, structured questionnaire was used to collect data which included the lifestyles, smoking habits, use of alcohol and physical activity and dietary habits. The questionnaires were completed by the students in their classrooms, and teachers supervised the procedure. The questionnaire was formulated in English.

History, examination and cardio-respiratory fitness function tests were done during this time period. An informed written consent was taken after explaining the procedure to the smokers and non-smoker subjects. History was asked about any cardiac or respiratory disease and regarding total duration of smoking. Examination was done and then cardio-respiratory fitness test was performed.

Exclusion Criteria:

- Students absent on the day of survey
- Students not willing to participate in the study.
- Chronic respiratory disease
- Cardiac disease
- Examination finding suggestive of respiratory or cardiac disease

Inclusion criteria

- Students present on the day of survey
- Students between the ages of 18–25 years.

Sample size: A pilot study was conducted involving smokers and non-smokers were included in the main study, aiming to test the proposed methodology. On the basis of selection criteria, a self-addressed questionnaire was given to all students (n= 100) in the department of Physiology, Bankura Christian College. The subjects were randomly selected from a target population of College. All students were divide into two groups 50 smoker (Group-I), 50 non-smoker (Group-II).

Smoking behavior: Subjects were classified as current smokers, ex-smokers and non-smokers (never smoked). Current smokers were classified into three ordered smoking volume sub-categories, depending on the daily number of cigarettes (cig/day) smoked: 1) <10 cig/day, light smokers; 2) <19 cig/ day, moderate smokers; 3) ≥20 cig/day, heavy smokers. Among other data, age at smoking initiation and smoking years were also recorded.

Anthropological parameters assessment:

Determination of BMI;

A Measurement of height and weight: Height and weight was measured by using standard protocol. The body mass index (BMI) was calculated as body mass (kg) divided by height squared (m^2). The readings were taken to the nearest 0.1cm. The BMI was calculated as the weight in kilograms divided by the square of the height inmeters [weight (kg) /height (m^2)]. Subjects were categorized as per WHO classification on BMI.

Measurement of Pulse rate and Blood pressure: Pulse rate is measured in right radial artery, after all participants had rested for at least 10 mins before and after exercise. Blood pressure was measured by the auscultatory method and was analysed by standard protocol [31].

Pulmonary Function Tests: The pulmonary function tests were carried out by using spirometer with standard protocol.

Determination of PEFR: Peak expiratory flow measurement is a quick test to measure air flowing in and out of the lungs. The measurement is called the peak expiratory flow rate (PEFR). It's also known as the peak expiratory flow (PEF). Peak flow measurement is mostly done by people who have asthma. Peak flow measurement can show:

1. The amount of air breathed in,
2. The amount of air breathed out,
3. The rate at which the air is breathed in and out from the lungs.

Peak expiratory flow is typically measured in units of liters per minute (L/min). Green zone-80 to 100 percent of the usual or normal peak flow reading is clear. Yellow zone-50 to 79 percent of the usual or normal peak flow reading. Red zone- Less than 50 percent of the usual or normal peak flow reading.

Determination of O_2 saturation: Oxygen saturation is the fraction of oxygen-saturated hemoglobin relative to total hemoglobin in the blood. The human body requires and regulates a very precise and specific balance of oxygen in the blood. Normal blood oxygen levels in humans are considered 95–100 percent. If the level is below 90 percent, it is considered as low, resulting in hypoxemia. A pulse oxymeter is a medical device that indirectly monitors the oxygen saturation of a person's blood (as opposed to measuring oxygen saturation directly through a blood sample) and changes in blood volume in the skin, producing a photo-plethysmogram.

Measurement of Respiratory Rate: The respiratory rate is measured when a person is at rest and involves counting the number of breaths for one minute by counting chest movements.

Determination of Physical Fitness Index (PFI): The resting pulse rate of the subject is recorded before the study. The subject should wear shorts and rubber-soled shoes. The subject should stand before bench or stool and as soon as asked to start, the subject should place one foot on the bench or stool step up placing both feet on the platform, straighten the legs and back and immediately step down again, bringing down first the same foot he or placed up first. After every 3 seconds intervals the same order of stepping should be repeated. This order of stepping down and up with the rhythms of the metronome, or with the shout of an observer as 1,2,3,4 – 4,3,2,1-or "up-

down", should be continued at the rate of 20 steps per minute for a period of the exactly 3 minutes (180 sec).

The subject should begin with the same foot (right or left as the case may be) each time and should not touch anything with the hands which may be moved freely, during the period of exercise. Immediately after the exercise the subject should sit quietly on a chair and the pulse rate should be counted after exactly 1 minute for 30 sec period at the following recovery interval after exercise: (like one to one and half min; two to two and half min and three to three and half min) after exercise is over.

PFI Calculation: The physical fitness of the subject is then scored on an index of the fitness combining in direct proportion the duration of exercise and in inverse proportion, the sum of the pulse rate during early period of recovery as per the following equation;

$$\text{Physical Fitness Index (PFI)} = \frac{\text{Duration of exercise in seconds x 100}}{\text{2 x sum of three recovery pulse rate for 30 sec period (1-1 and ½ + 2- 2 and 1/2 + 3-3 and 1/2)}}$$

Assessment for Handgrip Strength: The most common method of assessment for grip strength is the use of a handheld dynamometer. Handheld grip strength dynamometry is used to measure the muscular force generated by flexor mechanism of the hand and forearm. Grip strength has long been thought of as a possible predictor of overall body strength. Grip strength may also play a role in injury prevention and rehabilitation.

The participant was in a standing position, arms at their side, not touching their body. Keeping elbow bent slightly. Administer the test on the non-dominant hand. Now by asking the participant to squeeze the dynamometer with as much force as possible, being careful to squeeze only once for each measurement. Three trials were made with a pause of about 10-20 seconds between each trial to avoid the effects of muscle fatigue.

Statistical Analysis: To compute mean difference between the smoker and non-smoker subjects in relation to selected physical fitness components mean, standard deviation and independent 't'-test were used. The data were analyzed statistically by using appropriate statistical tools such as mean, standard deviation and percentage. Coefficient of correlation and was also performed and the level of significance was also tested.

Results

Statistical analysis was performed on the data obtained from 100 subjects. The study group consisted of 100 college students (Group-I, Smoker and Group-II, Non-smoker), out of which equal number smoker and non-smoker College subjects with age matched. The mean age of smoker is 21.76±1.46 and for non-smoker it is 20.58 ±1.50.

Table-1 summarizes the demographic variables and anthropometric variables in terms of age, height and weight and body mass index and body surface area is also determined. The BMI value of smoker is 24.18± 2.78, which is greater than the non-smoker 22.25±2.87.

The body surface area of smoker is slightly greater than the non-smoker college students. It was observed that the television viewing hours of non-smoker college student is much greater than the smoker college students. On the other hand, the leisure time of smoker college student is much more than the non-smoker college students (Figure 1).

Fig- 1: Comparative study of age, BMI and BSA among the study population

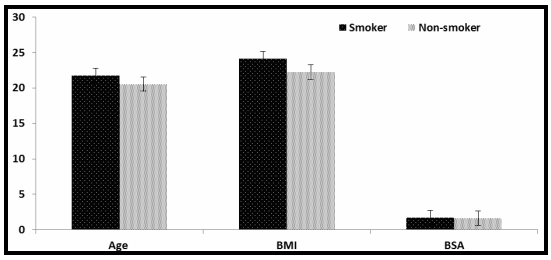

Table-1: Anthropometric variable & life style parameters among the study population			
Variables	**Group I (Smoker)**	**Group II (Non-Smoker)**	***p* value**
Age (Yrs)	21.76 ±1.46	20.58 ±1.50	NS
Height (mts)	1.68 ±0.04	1.68 ±0.05	< 0.001
Weight (kgs)	65.84 ±8.67	57.65 ±9.35	< 0.001
BMI (Kg/m^2)	24.18 ±2.78	22.25 ±2.87	< 0.001
BMI grades			
Underweight (%)	2.9	5	< 0.001
Normal-weight (%)	73	81	< 0.001
Overweight (%)	19	12	< 0.001
Obese (%)	5.1	2	< 0.001
BSA (m^2)	1.71 ±0.12	1.64 ±0.14	**0.001**
Life style parameters			
Sports / Physical activity (min/day)	40 ±10	90 ±15	< 0.001
Television viewing hours (min/day)	70 ±15	82 ±12	< 0.001
Leisure time (min)	90 ±10	35 ±5	< 0.001
BMI: Body mass index; BSA: Body surface area. NS: non-significant; Age, Height, Weight, BMI, BSA and life style parameters are expressed as mean ± SD.			

Table 2 shows the level of cigarette smoking for smoker. Result shows that 32 students are smoking <10 cigarettes daily, 16 students are smoking <19 cigarettes per day and only 2 students smoke ≥20 cigarettes daily.

Table-2: Status of smoking among smoker and non-smoker		
Smoking status	**Group I (Smoker)**	**Group II (Non-Smoker)**
Current	50	00
<10 cigarettes daily	32	00
10–19 cigarettes daily	16	00
≥20 cigarettes daily	2	00
Age of starting smoking [years, n (%)]		
≤14	12	00
15–16	24	00
17–18	14	00

Table 3 summarizes the physical activity level among smoker and non-smoker. Here, we have observed that smoker physical exercise level is less than the non-smoker. Usually, non-smoker physical activity level daily is more than the smoker.

Table-3: Duration of physical exercise among the study population		
Physical Exercise	**Group I (Smoker)**	**Group II (Non-Smoker)**
Less than 2 h weekly	32	24
3–7 h weekly	12	15
More than 1 h daily	6	11

Fig-2: Graphical representation of cardiovascular parameters among the study population

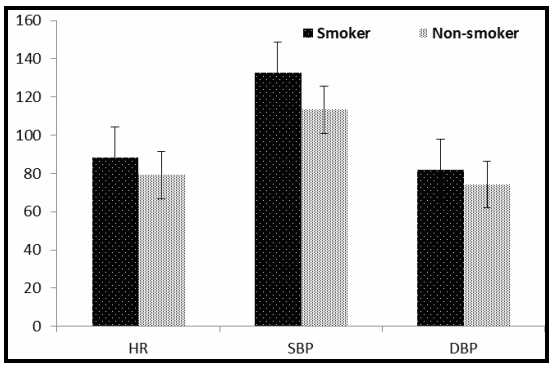

Table 4 summarizes the cardio-respiratory status among smoker and non-smoker college students. There is significant difference of BP of smoker and non-smoker college students. The value of SBP and DBP of smoker's college students is comparatively more than non-smoker (Figure-2).

The respiratory rate of smoker's college student is higher than that of non-smoker. Smokers strength of the respiratory muscle is less than non-smoker as a result they have less vital capacity. On the other hand the percentage of O_2 saturation is less than the non-smokers students.

Table-4: Comparison of cardio-respiratory status among the study population

Parameters	Group I (Smoker)	Group II (Non-Smoker)	*p* value
Heart Rate (beats/min)	88.28±12.68	79.1±8.68	<0.001
BP (mm of Hg)	SBP-132.80±18.162 DBP-81.75±8.76	SBP-113.32±12.12 DBP-74.30±9.52	<0.001
Respiratory Rate (times/ min)	34.35±5.84	16.45±3.82	<0.001
TV (ml)	400.76±28.84	500.64±26.37	<0.001
VC (L)	2.5±0.82	3.6±0.94	<0.001
PEFR (L/min)	291.33±131.80	350.38±87.08	<0.001
% of O_2 saturation	94.31±0.88	98.88±1.35	<0.001

TV: Tidal Volume; VC: Vital Capacity; PEFR: Peak Expiratory Flow Rate; Values are shown as mean ± SD.

Table 5 shows the hand grip strength among smoker and non-smoker college students. Smokers have less muscle strength than non-smoker.

Table-5: Comparison of muscle strength among the study population

Parameters	Smoker	Non-smoker
Muscle strength by Handgrip test		
Grip Strength Left (kg)	38.01±7.62	51.53±7.35
Grip Strength Right (kg)	36.41±12.38	61.23±8.94

Results are shown as mean ± SD.

Discussion

Smoking is still a universal leading cause of preventable morbidity and premature mortality, especially in low and middle income countries. Smoking is a major risk factor for cardiovascular morbidity and mortality and is considered to be the leading preventable cause of death in the world.

According to WHO estimates, tobacco continues to kill nearly 6 million people each year, including more than 600,000 passive smokers, through heart disease, lung cancer and other illnesses; that is one and a half million more than the corresponding estimate for 1990. If current trends continue, the death toll is projected to reach more than 8 million per year by 2030 [4]. This study showed that cigarette smoking had a close relationship with physical inactivity and smokers tended to have less exercise capacity, compared to non-smokers.

Smoking is associated with an increased risk of all types of cardiovascular diseases, chronic obstructive pulmonary disease and some cancers [32-33]. Internationally, 25% of middle-aged cardiovascular deaths are attributable to smoking [24]. A number of physical endurance studies have shown that smokers reach exhaustion before non-smokers do and can't run as far or as fast as non-smokers.

Smoke contains many toxic chemicals and gases, with carbon monoxide as the chief offender. Smoking has a huge effect on blood vessels and the circulatory system as a whole. Smoking interferes with lung function and the ability of red blood cells to carry oxygen. It blunts the ability to raise heart rate to keep up the demands of exercise. Smokers get tired

more easily, have harder time breathing and have more leg pain during exercise.

Conclusion

Many college students smoke, but few smoke daily or are nicotine dependent. The present study showed that cigarette smoking negatively affects the quality of physical activity. Our study assessed cigarette smoking behavior among a diverse sample of college students and the association of cigarette smoking with a range of physical activities.

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