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# Effect Of Tobacco On Recovery After Physical Exercise: The Case Of Young Senegalese Smokers Aged Between 18 And 30

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***Abstract***

**Context**

In Senegal today, young boys smoke to demonstrate their emancipation and freedom. However, despite the efforts made by the country's authorities to raise awareness, they continue to smoke without worrying about the consequences of smoking on their physical health. It is for this reason that we propose to study the recovery of the heart of young Senegalese smokers after physical exercise.

**Methods**

The heart rates of 40 young boys, 20 smokers and 20 non-smokers, were recorded before the Ruffier and Dickson test, immediately at the end of the test and every minute after the test until the fifth minute of recovery. The mean values of age, weight and resting heart rate of the two groups were first compared using the T-STUDENT test, and then the variations in the mean heart rate values recorded immediately at the end of the Ruffier-Dickson test and at each minute of recovery up to the fifth minute were studied.

**Results**

The average heart rate of young smokers taken before the test was significantly higher than that of young non-smokers. Furthermore, a reading of the two variation curves shows that the average heart rate of the young non-smokers, reached at the end of the Ruffier-Dickson test, returns much more quickly to its resting value than that of the young smokers. At the fifth minute of recovery, the mean heart rate of the young non-smokers was almost equal to its resting value, whereas that of the young smokers was still a long way from its resting value

**Conclusion.**
The study shows that young non-smokers recover more quickly than smokers. The latter also had a higher resting heart rate.

**Keywords:** smokers; non-smokers; Ruffier-Dickson test; cardiac recovery; young boys.

## Introduction

Tobacco use is an act that decisively undermines our health and well-being. Today, smoking has become a global scourge and a problem with medical, social, economic, behavioural and psychological implications. It is responsible for at least five million deaths a year worldwide. It also causes 25 diseases, including cardiovascular disease, chronic lung disease and cancers of all kinds (Doll et al, 1994). The report on the smoking survey carried out by the Agence Nationale de Statistique et de la Démographie (ANSD, 2015) showed that in Senegal ½ million, or 6% of adults are smokers. Men are far more represented than women (0.4%) tobacco smokers. In addition, smoking, which for a long time was the preserve of adults, is now affecting, increasingly younger subjects.

The main constituents responsible for the toxicity of tobacco are carcinogenic substances, carbon monoxide and nicotine. The speed with which cigarettes are absorbed has led to a considerable increase in the risks associated with smoking. The complications of smoking, which were originally local with pipes, snuff and chewing tobacco, have now become general with cigarettes, affecting the whole body (Martinet and Bohadana, 2001).

After inhaling tobacco smoke, the substances it contains enter the lungs, cross the membranes of the alveoli and then enter the bloodstream. All these substances first pass through the oropharyngeal sphere: the mouth, nose, throat, etc., the hoarse voice, yellow teeth, bad breath, but also the gradual loss of taste and smell, are all well-known annoyances for smokers (Darde, 2020). These substances then travel to the lungs, to the pulmonary alveoli. We know that the respiratory system is particularly at risk from these particles, especially those produced by burning tobacco. First of all, the tars that stick to the tissues and mucous membranes, particularly the lungs, larynx, pharynx etc. Then, these substances land in the respiratory tract. These substances then enter the bloodstream (Berlin, 2016). Returning to the heart via the pulmonary veins, this blood is ejected into the aorta to supply the body's various organs. However, the carbon monoxide produced by smoking is more concentrated in the alveolar air than in the blood arriving via the pulmonary artery. It passes

through the alveolar-capillary barrier and binds to the red blood cells that are supposed to transport oxygen (Berlin, 2016).

The respiratory and cardiovascular systems are the entry point for most toxic substances into the human body. These same systems are crucial in activating the body during physical effort. On this basis, it can be said that a dysfunction or reduction in capacity due to tobacco use could considerably reduce or slow down the effectiveness of these systems. This raises the question of how well a smoker's heart recovers after physical effort. Recovery is a period set aside for the body to induce higher-than-normal metabolic activity compared with a period of pure rest, during which all the systems stressed during exercise are restructured (Bacquaert, 2022). There are two types of recovery: active recovery, during which the subject continues to engage in low-intensity physical activity, and passive recovery, during which the person is at rest.

In this research work, we are going to focus on the post-exercise period in an attempt to understand the recovery process of young smokers after the Ruffier-Dickson test (Mondenard, 1987) using heart rate as a tool. In order to achieve our general objective, we need to attain the following specific objectives:

- record the subjects' heart rate before the Ruffier and Dickson test;
- record the subjects' heart rate immediately at the end of the Ruffier and Dickson test;
- record the subjects' heart rates after each minute until the $5^{th}$ minute recovery period;
- compare changes in the mean heart rate of the experimental group (smokers) recorded at the end of the Ruffier and Dickson test with that of the control group (non-smokers) up to the fifth minute of recovery.

## Materials and methods

### 2.1 Hardware

#### *2.1.1 Study sample*

Our study sample consisted of forty (40) young men aged between 18 and 30 of Senegalese nationality, living in the same neighbourhood in Pikine, who occasionally played football in the streets of the neighbourhood. They were divided into two equal groups. The experimental group (group 1) consisted of 20 young people who regularly used tobacco. The control group (group 2) was made up of 20 young non-smokers. They gave their consent by signing the relevant form.

#### *2.1.2 Instruments used*

We used the following instruments:

- a wrist-mounted heart rate monitor (Kalenji ONRHYTHM110) for direct reading of heart rate;
- A scale (Generic balance) to measure the weight of the subjects;
- a well-equipped room for the subjects;
- two sports mats (Decathlon) on which the subjects lie at rest;
- a metronome enabling subjects to perform the thirty (30) squats in 45 seconds.

## 2.2 Methods

### *2.2.1 Description of the Ruffier and Dickson test*

The Ruffier-Dickson test (Mondenard, 1987) is a cardiac recovery test used to assess fitness for sport. The Ruffier-Dickson test should be performed under the supervision of a health or physical activity professional. This test gives a better idea of a person's state of fitness, based on their heart rate following a well-known bodybuilding exercise, the free squat.

The Ruffier-Dickson test consists of three stages.

- To begin with, the subject must be at rest, lying on the floor. At this point, the heart rate is recorded, giving the F0 value, expressed in beats per minute.
- The subject then stands up and performs thirty (30) squats in 45 seconds with his arms stretched out in front of him. At the end of the 45 seconds of effort, the heart rate recorded represents F.
- Finally, the subject lies down again and after one (1) minute's rest, the heart rate is taken one last time, giving F1.

This is the protocol for the Ruffier-Dickson test, but for the purposes of our study we will continue to record the subjects' heart rate every minute until the fifth minute of recovery.

### *2.2.2 Process*

The test was carried out over two days using the same procedure in a gym in Pikine (BATORA FITNESS CLUB). Smokers were tested on the first day and non-smokers on the second.

The subjects were called at 9am and were registered in order of arrival. The subject has to:

- take off all his personal belongings: watch, bracelet, chain, telephone, shoes;
- get on a scale to measure his weight;
- carry the heart rate monitor;
- then lie on his back with arms with legs stretched out on a sports mat for five minutes, after which the heart rate is recorded and displayed on the watch as F0;
- stand up and immediately perform 30 squats in 45 s, the subject's heart rate F being again recorded;
- lie down again on the treadmill and with his heart rate recorded every minute until the fifth minute (F1, F2, F3, F4 and F5).

*2.2.3 Statistical processing*

The aim of this study was to investigate the impact of smoking on the recovery of young boys aged between 18 and 30. To do this, the mean heart rates of the two groups at rest, immediately after the Ruffier-Dickson test and every minute up to the fifth minute of recovery were compared.

Variables that could influence our results were controlled. For example, we compared age, weight and resting heart rate.

These comparisons of means were made using the T-STUDENT test, after checking that the variances of the two groups were equal for each variable studied.

Our probability of error **α is** set at 5% (0.05).

The evolution of the mean heart rate of the two groups from the start to the fifth minute of recovery after the Ruffier and Dickson test is represented graphically.

**Results**

**Table 1: Comparison of the average age of the two groups**

| Age (years) | Average values |
|---|---|
| Smokers | 23.15±3.69 |
| Non-smokers | 22.05±3.91 |
| **α** (error probability threshold) | 0.05 |
| **p** (value found) | 0,32 |
| **Decision** | **P** is greater than **α,** no significant difference between the two groups. **H0 is confirmed** |

Analysis of this table enabled us to compare the mean ages of the two groups in our sample. This comparison showed no significant difference because the probability of error found in the T-STUDENT test was **0.32,** strictly greater than **0.05. This means that age could not influence the results of our study.** We can therefore say that age could not influence the results of our study.

**Table 2: Comparison of the average weight of the two groups**

| Weight (Kg) | Average values |
|---|---|
| Smokers | 68.75±5.43 |
| Non-smokers | 65.6±5.68 |
| **α** (error probability threshold) | 0.05 |
| **p** (value found) | 0,42 |
| **Decision** | **P** is greater than **α**, no significant difference between the two groups. **H0 is confirmed** |

Comparison of the mean weight values of the two groups revealed no statistically significant difference, as the probability of error associated with these means in the T-STUDENT test was **0.42**, greater than the probability of error (**0.05).** There was therefore no significant difference in weight between the two groups. This comparison shows that weight could not bias our study.

**Table 3: Comparison of the average heart rate of the two groups at rest before the Ruffier and Dickson test:**

| FCR (beats/min) | Average values |
|---|---|
| Smokers | 74.55±3.62 |
| Non-smokers | 62.75±6.23 |
| **α** (error probability threshold) | 0.05 |
| **p** (value found) | 0,005. 10-4 |
| **Decision** | **P** is less than **α, there is a** significant difference between the two groups at rest. **H1 is invalidated** |

**NB**: FCR represents the heart rate recorded at rest

The mean resting heart rate of the non-smoking group was 62 bpm, strictly lower in absolute value than the mean resting heart rate (74 bpm) of the smoking group. The probability of error found in the STUDENT test is 0.005. $10^{-4}$. This is less than the probability of error (0.05) set as the significance threshold (Table 3). On the basis of these results, we can say that at rest the hearts of smokers beat faster than those of non-smokers.

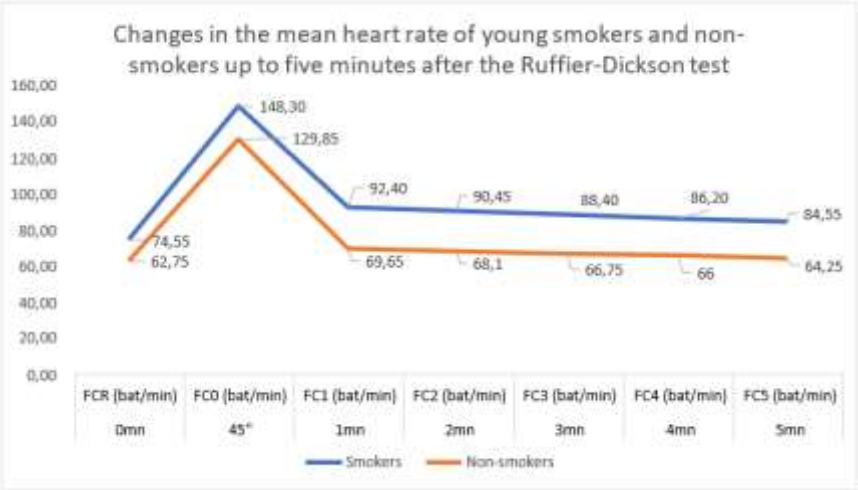


**Figure 1. Changes in the mean heart rate of young smokers and non-smokers up to five minutes after the Ruffier-Dickson test**

**Discussion**

The aim of our study was to compare the recovery of a group of non-smokers with that of a group of smokers after a Ruffier-Dickson test. The two groups showed no difference in age (23.15±3.69 vs 22.05±3.91 years) or weight (68.75±5.43 vs 65.6±5.68 kg). Age and weight were therefore controlled and could not bias the comparison of the two groups.

In terms of average resting heart rate, that of smokers (74.55±3.62 beats/min) was significantly higher than that of non-smokers (62.75±6.23 beats/min) p= 0.005. $10^{-4}$ . This significant difference in average resting heart rate could be caused by smoking, as the non- smokers and smokers in our sample engage in the same physical activities together. They play street football together in their neighbourhood. As a reminder, a cigarette causes smokers to raise their blood pressure for a period of 20 to 40 minutes, as well as increasing their heart rate by around 40%, which wears down the heart prematurely and weakens the walls of the arteries (French Federation of Cardiology, 2016). Furthermore, the only cardiovascular effect of nicotine is a transient increase in heart rate and blood pressure with each cigarette smoked, due to the sudden and high concentration of nicotine in the circulation associated with this method of administration (French Federation of Cardiology, 2016).

This difference in resting heart rate between the two groups in our sample is consistent with the results of Chagué et al (2014) who reported that tobacco (nicotine) consumption increases heart rate, blood pressure, cardiac output and myocardial oxygen consumption in athletes at rest. The results of our study are also in line with those of Bolinder et al (1997)

who observed higher blood pressure and heart rate values at rest in smokeless tobacco users aged 35 to 60.

At the end of the Ruffier-Dickson test, the average heart rate of smokers (148bpm) remained significantly higher than that of non-smokers (129bpm) $p=0.001\ 10^{-4}$ . The average heart rate of smokers increased during the Ruffier-Dickson test by 74 beats per minute, while

that of non-smokers increased by 67 beats per minute. The increase was greater for smokers. This greater increase in heart rate after the Ruffier-Dickson test in the smokers in our sample is in line with the changes in heart rate in Indian smokers aged 35 to 60 during a submaximal treadmill test (Bolinder et al, 1997).

Comparisons of the average heart rates of the two groups taken every minute up to the fifth minute after the Ruffier-Dickson Test again revealed significant differences, with smokers' heart rates always higher because smoking accelerates the heart rate. When you smoke, carbon monoxide takes the place of oxygen on the red blood cells. As a result, the heart needs to pump more blood to bring the oxygen it needs to the cells. These effects are further amplified by nicotine, which increases the workload on the heart, particularly the myocardium (Berlin, 2016). Recovery capacity is therefore greatly reduced with tobacco consumption, which is in line with the results of Hasmukh Dahyabhai Shah and Tejas T Prajapat (2022) who reported that aerobic capacity is significantly lower in adult Indian men aged 18 to 60 who use tobacco than in those who do not.

The curve showing the evolution of heart rate (figure 1) in our two groups after the Ruffier- Dickson Test corroborates Berlin's findings (2016). The non-smokers' heart rate fell much faster, returning almost to its resting value (62.75±6.23 beats/min) by the fifth minute, whereas the smokers' heart rate fell slowly, reaching a value (84.55 beats/min) by the fifth minute, far from its resting value (74.55±3.62 beats/min).

**Conclusion**

The average heart rate of young smokers taken before the test was significantly higher than that of young non-smokers. In addition, a reading of the two variation curves shows that the average heart rate of the young non-smokers recorded at the end of the Ruffier-Dickson test returns to its resting value much more quickly than that of the young smokers. In fact, at the fifth minute of recovery, the average heart rate of the young non-smokers is almost equal to its resting value, whereas that of the young smokers is still a long way from its resting value.

**Our study shows that:**

- the resting heart rate of young smokers aged between 18 and 30 was significantly higher than that of young non-smokers of the same age carrying out the same physical activities in their neighbourhood;
- the heart rate of young smokers aged between 18 and 30 increases much faster during a Ruffier-Dickson test than that of young non-smokers of the same age who carry out the same physical activities in their neighbourhood;
- the heart rate of young smokers aged between 18 and 30 after a Ruffier-Dickson test returned much more slowly to its resting value than that of young non-smokers of the same age and carrying out the same physical activities in their neighbourhood.

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