A LEVEL PHYSICAL EDUCATION

Summer Task

Welcome to A Level PE! We look forward to you joining us in September. This task is to help you with the anatomy and physiology part of the course.

This task is to be completed before you start with us and needs to be handed in to Mrs Shipway in your first lesson.

Completing this will help you understand some of the content you need to know.

TASK:

Produce an information sheet/s on how training can impact cardiovascular health and fitness. Use the attached sheet to use as guidance.

Use the internet to help you, any work you give in must be your own words.

Use a bibliography to keep a list of any books/websites you use to help you.

What your document must include:

A title: **The Impact of Health and Fitness on the Cardiovascular System**.

A header including: your name, Page numbers at the bottom of the page.

A bibliography that lists what books/websites you have used.

The Impact of Health and Fitness on the Cardiovascular System

Understanding the impact of physical activity and sport on the health and fitness of the individual

A major cause of the worrying trend of obesity is the accompanying shift towards a sedentary lifestyle alongside a modernised lifestyle. For example, there has been an increase in the amount of people who are sitting and using technology such as their phones and TV, rather than playing sport and being active. Obesity is a major contributor to many cardiovascular diseases, such as coronary heart disease, stroke, atherosclerosis and heart attacks. Encouragingly, physical activity can lessen the likelihood of suffering from these cardiovascular diseases, as well as from respiratory diseases such as asthma and chronic obstructive pulmonary disease.

Case Study

It has been predicted that half of the UK population will be obese by 2030.[1]

The impact of training on cardiovascular health

Regular training helps to improve an individual's cardiac output, via the increase in stroke volume, which helps improve the efficiency of the transport of oxygen. Alongside this is the reduced resting and exercising heart rate, which helps to put less strain on the cardiac muscle. Regular training also helps to reduce the number of risk factors which can contribute to cardiovascular disease; such as coronary heart disease (CHD), stroke, atherosclerosis and heart attacks. One of these risk factors is high blood pressure. Training can lower the volume of low-density lipoproteins (LDL) in the blood, which helps to lower blood pressure. It can also increase high-density lipoproteins (HDL), referred to as 'good cholesterol', which helps to regulate blood pressure. Exercise has also been shown to increase the size of the coronary artery, reducing the risk of artery blockages and blood clots, allowing blood flow to be unrestricted. Training helps to lower body fat levels, which helps to reduce the risk factor of obesity.

Let's take a look at each of these health issues and how exercise can help reduce them;

Cardiovascular health issue	What it is	How exercise reduces risk
Coronary heart disease	A disease which involves the restriction of the coronary arteries (the arteries that supply blood to the heart) due to a build-up of cholesterol / fatty substances.	Exercise helps to reduce the amount of energy that is stored as fat within the body, reducing the number and size of fatty build-ups.
High blood pressure	A blood pressure of 140/90 mmHg or above that puts strain on the heart muscle and blood vessels, increasing the likelihood of heart attacks or strokes. Also known as hypertension.	Exercise ensures that the arteries and other blood vessels are well maintained and stay flexible, reducing any resistance to blood flow.
Cholesterol build up	When cholesterol combines with fatty substances and forms a plaque that builds up in the arteries and causes blockages that can lead to heart attacks and strokes.	Exercise helps to increase the amount of good cholesterol (HDL), and lower body fat composition which helps to reduce cholesterol levels.
Stroke	An urgent medical condition that involves blood flow to the brain being restricted or cut off, leading to a reduction in oxygen that causes brain cells to die.	Exercising helps to reduce obesity levels, which is a cause of strokes as being obese can lead to plaque build-up in the arteries, and therefore a blood clot which can restrict the blood flow to the brain.

[1] http://www.nhs.uk/news/2011/08August/Pages/half-of-uk-predicted-to-be-obese-by-2030.aspx

The impact of training on cardiovascular fitness

Different types and intensities of exercise have a wide range of effects on the cardiovascular system. When exercising, a great level of stress can be placed on the body, be it a greater demand for oxygen or a greater amount of force that needs to be exerted to overcome a resistance. Maximal exercise has a more pronounced effect on the values shown below, relative to sub-maximal exercise, as the body is going under a greater level of stress and the demand for oxygen is much higher. To cope with this stress, the cardiorespiratory system has to work harder to ensure the full functioning of the exercising muscles. If this system is inefficient, the body cannot function optimally. It is therefore important to firstly gain an understanding of the baseline values of the key cardiovascular values. This way it is easier to determine the magnitude of an effect that each form of exercise has on these values. The values which can be considered most important are heart rate, stroke volume and cardiac output. These have a close relationship, which will be explained in more detail below.

Heart rate		Stroke volume		Cardiac output
Definition: the number of times the heart beats per minute	X	**Definition:** the amount of blood ejected from the heart per beat	=	**Definition:** the volume of blood ejected by the heart per minute
Average resting value: 70 beats per minute (bpm)		**Average resting value:** 70 ml		**Average resting value:** 4900 ml/minute
The resting heart rate can vary for each individual, but generally the fitter the individual, the lower their resting heart rate. For example, Olympic time-trial Champion and Tour de France winner Miguel Indurain recorded a resting heart rate of just 28 bpm. Having a low resting heart rate demonstrates that the heart is efficient in transporting blood around the body, which means that the heart undergoes less undue strain, lessening the risk of cardiovascular diseases.		Having a higher stroke volume allows the heart rate to be lowered, due to the relationship that stroke volume and heart rate have in determining cardiac output. The benefits of a lowered heart rate have been mentioned to the left.		Cardiac output is the direct result of the relationship between heart rate and stroke volume. This value increases alongside an increase in heart rate and stroke volume, but as these values reach their maximal levels and begin to plateau, so does cardiac output.

Exam Tip

Think about how this calculation may be altered in the exam if different values were given. What calculation would you use if you were asked to work out the stroke volume? Or the heart rate?

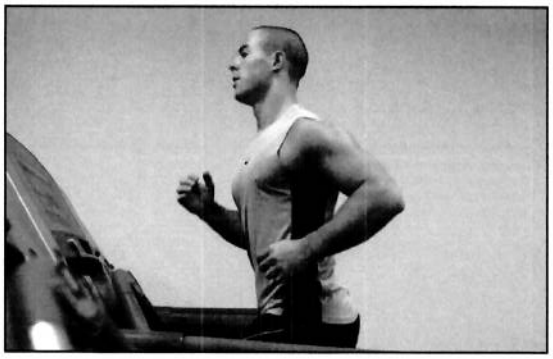
To explain this equation in greater detail a worked example has been completed for you below:

Jim, an amateur cross-country runner, has a resting heart rate of 65 bpm and a stroke volume of 85 ml.

Using the equation above, Jim's cardiac output can be calculated:

- Cardiac output = heart rate x stroke volume
- Cardiac output = 65 × 85
- Cardiac output = 5525 ml/min

Most people are aware that the heart rate changes during exercise, however there are a number of changes that are taking place to the cardiovascular system due to the stresses put on the body during exercise. As our body demands more oxygen to be delivered to the working skeletal muscles, adaptations have to occur within the cardiovascular system in order to redistribute blood to the muscles that need it. This is because of the greater demand for oxygen from the working skeletal muscles. However, it is also important to understand how the mechanisms of blood return are affected by exercising and the changes to the cardiovascular system that this results in.



We know that from the equation previously mentioned, cardiac output is increased as a result of heart rate and stroke volume increasing as we begin to exercise. However, did you know that stroke volume only increases up to approximately 60% of maximal exercise intensity and then plateaus (levels off)? The heart can only eject so many millilitres (ml) of blood per heartbeat. This means that any additional increase in cardiac output has to be as a result of the continuing increase in heart rate.

The table below helps to demonstrate the difference between the cardiovascular measurements at rest and during moderate-intensity exercise.

Cardiovascular measurements	At rest	Typical value at moderate-intensity exercise	Difference	Effect
Heart rate (bpm)	70	115	45	↑
Stroke volume (ml)	70	90	20	↑
Cardiac output (ml/min)	4,900	10,000 (10 L/min)	5,100	↑

While we can see the effects moderate-intensity exercise has on the cardiac values above, it is also important to consider how these change for high-intensity exercise such as sprinting. The table below demonstrates the differences between cardiovascular measurements at rest and during high-intensity exercise. How does this differ to moderate-intensity exercise?

Cardiovascular measurements	At rest	Typical value at high-intensity exercise	Difference	Effect
Heart rate (bpm)	70	135	65	↑↑
Stroke volume (ml)	70	110 (untrained) 160 (trained)	40 (untrained) 90 (trained)	↑↑
Cardiac output (ml/min)	4,900	17,500 (17.5 L/min)	12,600	↑↑

Things to think about *for discussion and thought*

What effect can an improvement in the cardiovascular and respiratory systems' efficiency have on sporting performance?

