

Laboratory Practical

Establishing cardiovascular health

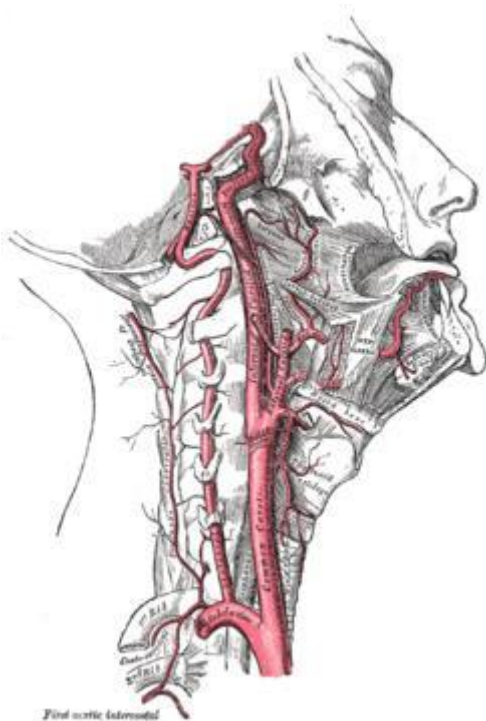
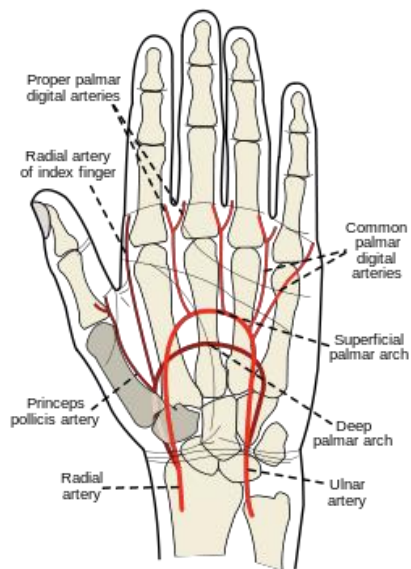
As exercise professionals, we often use heart rate to indicate cardiovascular status and fitness of our patients/clients. Heart rate is defined as the number of contractions of the heart in a given time frame, usually expressed as beats per minute (bpm). The heart rate can vary according to the body's physical needs, including the need to absorb oxygen and excrete carbon dioxide. The normal resting adult human heart rate ranges from 60–80 bpm. Bradycardia is a slow heart rate, defined as below 60 bpm. Tachycardia is a fast heart rate, defined as above 100 bpm at rest.

Measuring Heart Rate

Manual measurement of heart rate is usually performed by finding the pulse of the heart. This pulse rate can be found at any point on the body where the artery's pulsation is transmitted to the surface by pressuring it with the index and middle fingers; often it is compressed against an underlying structure like bone. The thumb should not be used for detecting and measuring a pulse as it has a strong pulse of its own and may lead to the incorrect detection of a pulse where none is present or the incorrect measurement of your own pulse rather than the patients.

The most common sites for manually measuring a pulse are either the radial artery in the wrist or the carotid artery in the neck.

The radial artery can be located lateral in the anatomical snuff box.



The pulse is taken by palpating the artery just deep to the anterior border of the sternocleidomastoid muscle at the level of the superior border of the thyroid cartilage

Although we measure heart rate in Beats per Minute (bpm) we often measure pulse over a shorter duration and adjust the figure to reflect 1 minute, e.g. 15sec sample multiplied by 4, or a 10sec sample multiplied by 6.

Alternatively an electronic measurement can be made by a heart rate monitor using the Polar monitor.

Practical Task

Radial HR (Bpm)	HR Monitor (Bpm)	Percent difference

QUESTION

An individual with a low resting heart rate..... do they have OR are likely to have good cardiorespiratory fitness?

Heart Rate Maximum

The maximum heart rate (HRmax) is the highest heart rate an individual can achieve without severe problems through exercise stress and generally decreases with age. This can be directly measured through maximal testing (i.e. testing to maximal exhaustion by means of a cardiac stress test) however this is ill advised in unhealthy, unfit or unwell individuals as their response to volitional exhaustion may be extreme and potentially harmful. An alternative to the direct measurement of HRmax is an estimation of HRmax. A number of formulas are used to estimate HRmax.

Formula	Authors	My calculated HRmax (Bpm)
$HR_{max} = 220 - \text{age}$	Haskell and Fox (1970)	
$HR_{max} = 208 - (0.7 \times \text{age})$	Tanaka, Monahan, & Seals (2001)	
$HR_{max} = 205.8 - (0.685 \times \text{age})$	Robergs and Landwehr (2002)	

Heart Rate Reserve

Heart rate reserve (HRreserve) is the difference between a person's measured or predicted maximum heart rate and resting heart rate. It takes into account the patient's resting heart rate and as such is useful for unfit or unhealthy clients and is used in the prescription of exercise intensity for GP Exercise Referral Patients. Additionally, as a person increases their cardiovascular fitness, their HRrest will drop, thus the heart rate reserve will increase.

Use the following equation to estimate your Heart Rate Reserve (HRreserve): $HR_{reserve} = HR_{max} - HR_{rest}$

Measuring Blood Pressure

Blood pressure (BP) is the pressure exerted by circulating blood upon the walls of blood vessels. The term 'blood pressure' usually refers to the arterial pressure of the systemic circulation, usually measured at a person's upper arm. A person's blood pressure is usually expressed in

terms of the systolic blood pressure (SBP) over diastolic blood pressure (DBP) and is measured in millimeters of mercury (mm Hg).

Systolic blood pressure is defined as the amount of pressure exerted by the blood upon the walls of the blood vessels when the heart is contracting (in systole and therefore under a lot of force).

Diastolic blood pressure is defined as the amount of pressure exerted by blood upon the walls of the blood vessels when the heart is in a relaxed or in a state of diastole. This is usually a low force environment.

Normal resting blood pressure for an adult is approximately 120/80 mm Hg (SBP/DBP).

Manual measurement of blood pressure

Manual measurement of blood pressure requires auscultation (from the Latin word meaning to listen) using a stethoscope and a sphygmomanometer (pressure cuff).

A sphygmomanometer cuff is placed around the upper arm. Your left and right arm will have slightly different blood pressure readings so it is useful if you standardise the arm you use for testing for consistency.

Korotkoff sounds

Korotkoff sounds are the sounds that medical personnel listen for when they are taking blood pressure using a non-invasive procedure. There are 5 Korotkoff sounds:-

1. The first Korotkoff sound is the snapping sound first heard at the systolic pressure. Clear tapping, a repetitive sound for at least two consecutive beats is considered the systolic pressure.

2. The second sounds are the murmurs heard for most of the area between the systolic and diastolic pressures.
3. The third sound was described as a loud, crisp tapping sound.
4. The fourth sound, at pressures within 10 mmHg above the diastolic blood pressure, was described as "thumping" and "muting".
5. The fifth Korotkoff sound is silent as the cuff pressure drops below the diastolic blood pressure. The disappearance of sound is considered diastolic blood pressure – 2 mmHg below the last sound heard.

The second and third Korotkoff sounds have no known clinical significance.

A cuff of appropriate size is fitted around the patient's upper arm, and then inflated manually by repeatedly squeezing a rubber bulb until the artery is completely occluded. Listening with the stethoscope to the brachial artery at the antecubital fossa over the anterior aspect of the elbow, the examiner slowly releases the pressure in the cuff. When blood just starts to flow in the artery, the turbulent flow creates a "whooshing" or pounding (first Korotkoff sound). The pressure at which this sound is first heard is the systolic blood pressure. The cuff pressure is further released until no sound can be heard (fifth Korotkoff sound), at the diastolic arterial pressure.

Classification of blood pressure for adults:

Blood Pressure Category	Blood Pressure Reading in mmHg		
	Minimum	Maximum	
High Blood Pressure - stage 4 (Hypertension - stage 4)	Above 210 Above 120		Hypersensitive Crisis
High Blood Pressure - stage 3 (Hypertension - stage 3)	$\frac{180}{110}$	$\frac{210}{120}$	
High Blood Pressure - stage 2 (Hypertension - stage 2)	$\frac{160}{100}$	$\frac{179}{109}$	
High Blood Pressure - stage 1 (Hypertension - stage 1)	$\frac{140}{90}$	$\frac{159}{99}$	
Pre- High Blood Pressure (Pre-hypertension)	$\frac{130}{85}$	$\frac{139}{89}$	www.treatcure.com
High Normal Blood Pressure	$\frac{121}{81}$	$\frac{129}{84}$	
Normal Blood Pressure (Ideal Blood Pressure)	$\frac{100}{65}$	$\frac{120}{80}$	Normal Blood Pressure
Low Normal Blood Pressure	$\frac{90}{60}$	$\frac{99}{64}$	
Low Blood Pressure (Moderate Hypotension)	$\frac{70}{40}$	$\frac{89}{59}$	
Too Low Blood Pressure (Severe Hypotension)	$\frac{50}{35}$	$\frac{69}{39}$	Dangerously Low Blood Pressure
Extremely Low Blood Pressure (Extremely Severe Hypotension)	Below 50 Below 35		

Pulse Pressure_____

Pulse pressure is the difference between the systolic and diastolic pressure readings. It is measured in millimeters of mercury (mmHg). It represents the force that the heart generates each time it contracts. If resting blood pressure is 120/80mmHg then the pulse pressure is 40mmHg.

Low (Narrow) Pulse Pressure

A pulse pressure is considered abnormally low if it is less than 25% of the systolic value.

High (Wide) Pulse Pressure

Usually, the resting pulse pressure in healthy adults, sitting position, is about 30-40 mmHg. The pulse pressure increases with exercise due to increased stroke volume and healthy pulse pressure values can increase 100 mmHg.

Recent work suggests that a high pulse pressure is an important risk factor for heart disease.

Practical Tasks

1. Working in small groups, allow your subject to sit quietly for 5 min before measuring his/her resting heart rate and blood pressure. Record the resting values.
2. Start the participant exercising at 200W for 3mins
3. Measure BP during the 3rd min. Start inflating cuff after 2mins. This will give adequate time to take BP.
4. Record HR at the end of the 3 mins.

5. Increase work to 250W
6. Measure BP DURING the 6th min
7. Record HR at the end of the 6th min

	Resting	3 mins	6 min
HR			
SBP			
DBP			
PP			

DISCUSSION:

How useful is pulse pressure as an indicator of heart health?

How did you ensure reliability of procedure with your testing?

