The Physiological Society of Sri Lanka

NEWSLETTER

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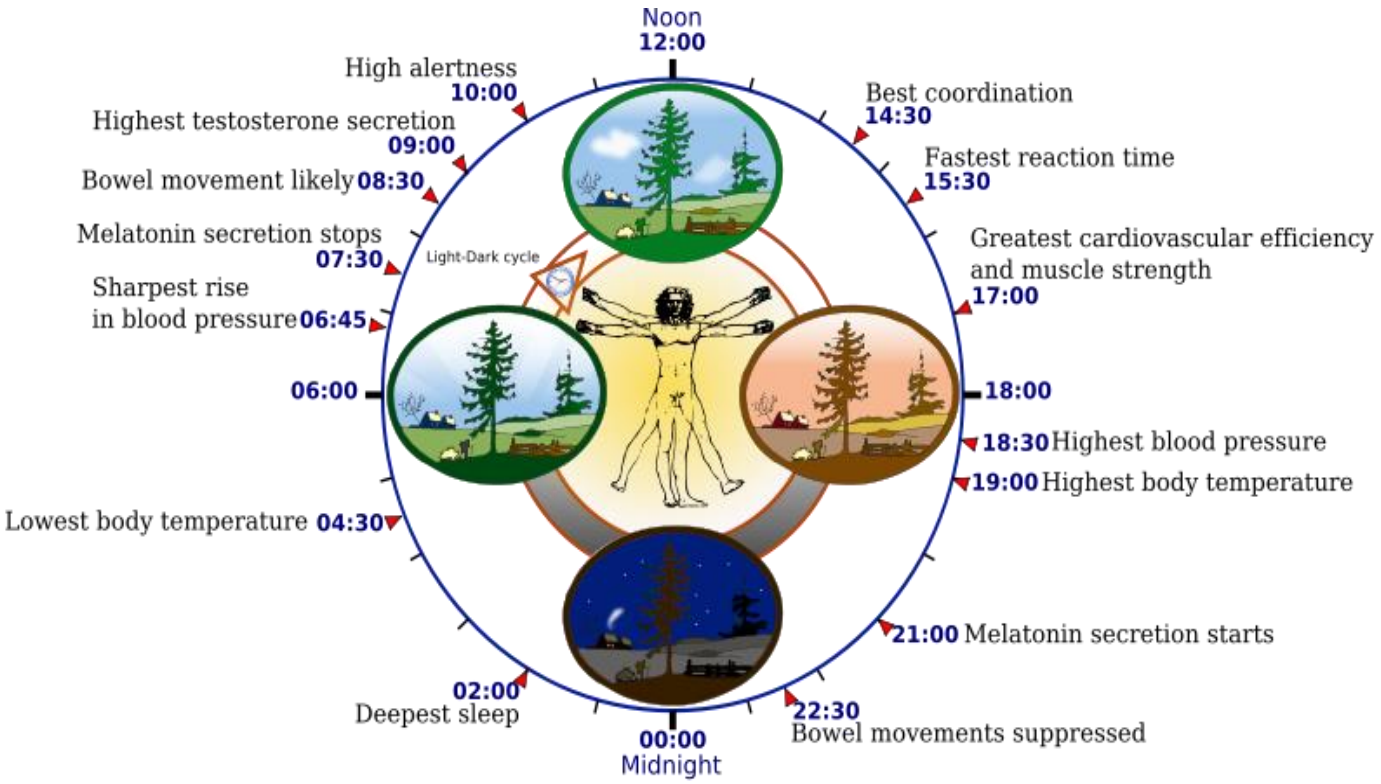

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Description of front page picture

Overview of biological circadian clock in humans. Biological clock affects the daily rhythm of many physiological processes. This diagram depicts the circadian patterns typical of someone who rises early in morning, eats lunch around noon, and sleeps at night (10 p.m.). Although circadian rhythms tend to be synchronized with cycles of light and dark, other factors - such as ambient temperature, meal times, stress and exercise - can influence the timing as well.

https://commons.wikimedia.org/wiki/File:Biological_clock_human.svg

Editorial

It is wonderful to welcome you to news and information in Physiology with the newsletter of the year 2018. The year commenced with the Nobel prize for Physiology and Medicine for 2018 being awarded to Drs. Jeffrey C. Hall, Michael Rosbash and Michael W. Young for their discoveries of “molecular mechanisms controlling the circadian rhythm." Indeed, the spark of day night cycle has had an effect on generating the circadian rhythm for all plants and beings.

The scientists discovered how the inner clock of a life-form can fluctuate to optimize our behavior and physiology. Their discoveries explain how the biological rhythms of plants, animals and humans adapt to synchronize with the revolutions of the Earth. These changes now have been found to be associated with many changes observed in the human body including the onset of serious disease with sleep deprivation and obesity induced metabolic diseases.

Amongst the activities of the Physiological Society, the Inter-Medical Faculty Quiz in Sri Lanka was an event that brought the students and staff of 8 medical faculties together in healthy competition. I have the pleasure to include some of the highlights and photos of the event in this issue for you.

The annual academic sessions mark the 31st anniversary of the society and is an opportunity to look back on our achievements and plan our future directions. 31st Annual academic sessions of the PSSL will be held on the 16th – 17th November 2018. The sessions are packed with interesting topics and it will be an academic event not to be missed. We physiologists are a closely bonded family. I look forward to a happy meeting with academics and camaraderie.

Prof. S. W. Wimalasekera,

Editor PSSL.

President's Message

It's a great pleasure to send a message through the PSSL newsletter 2018. At this juncture we as a society have successfully completed several activities planned at the beginning of the year 2018. We had our regional meeting on the 16th March 2018 in the Faculty of Medicine Ruhuna. At this meeting Dr. Himan de Silva of Sports Unit, Karapitiya Teaching Hospital emphasized the importance of 'Exercise and Medicine'. The participants had an exciting experience of performing resistance exercise using the resistance bands.

We were also pleased to listen to Prof. Sampath Gunawardena's speech regarding "low cost improvised devices useful to teach medical Physiology". Prof. K. D. Mahinda's comparison of 'Science vs Pseudoscience' also gave a new insight into what we are already doing in our day today life. The visit to the Martin Wickremasinghe Museum was an afternoon filled with social interaction amongst the physiologists.

The next interesting event in our calendar was the Inter Medical Faculty Physiology Quiz. This was held on 9th of June 2018 with the participation of students and staff of the 8 medical faculties. After this magnificent event our next target is to conduct a pre congress workshop for those interested in statistical analysis of data. It is aimed at improving the knowledge of statistics amongst postgraduate students and physiologists. The resource person will be Prof. Tharaka Dassanayake and it will be held at the Faculty of Medicine, University of Kelaniya.

We are on the verge of finalizing our program for the 31st annual academic sessions on the 16th - 17th November. At this event, founder eminent physiologists, namely, Prof. Valentine Basnayake, Prof. A. C. E. Koch, and Prof. K. N. Seneviratne will be commemorated by 3 prestigious orations. Physiology being a discipline of interest forms the foundation for many other disciplines such as surgery, medicine, gynecology and obstetrics etc.

I take this opportunity to acknowledge the members of the executive committee of the Physiological Society and our Secretary Dr. Dulani Kottahachchi, for their tireless effort and their contributions in every event. I look forward to your participation at the pre congress workshop and the annual sessions.

Prof. Priyadarshika Hettiarachchi,

President, PSSL

5th Inter-Medical Faculty Physiology Quiz for Prof. Carlo Fonseka Challenge Trophy

The Fifth Annual Inter-Medical Faculty Physiology Quiz organized by the Physiological Society of Sri Lanka (PSSL) was held at the New Examination Hall, Faculty of Medical Sciences, University of Sri Jayewardenepura on the 16th of June 2018. About 250 students and members of staff from medical faculties of 8 state universities in Sri Lanka participated. The programme was a resounding success with the team from the Faculty of Medical Sciences, University of Sri Jayewardenepura becoming the winners and receiving the coveted Prof. Carlo Fonseka Challenge Trophy.

The chief guest was Prof. Surangi Yasawardena, Dean, Faculty of Medical Sciences, University of Sri Jayewardenepura. The President of the PSSL, the secretary, the Dean, the Quiz Master Dr. Anuruddha Abeygunasekera, past presidents of PSSL, senior physiologists and one student representative from each faculty, lit the 'lamp of learning' to inaugurate the session. Prof. Priyadarshika Hettiarachchi, the president

Professor Carlo Fonseka Challenge Trophy

Prof. S. Yasawardena lighting the lamp of learning

PSSL, in her welcome address, emphasized the importance of this event in promoting the knowledge of physiology among medical students in Sri Lanka. Prof. Surangi Yasawardena expressed her pleasure in hosting this activity at the University of Sri Jayewardenepura as it promotes both undergraduate learning and social harmony among students and staff from all parts of the country.

After the draw which decided on the order of the teams in the competition, Dr. Anuruddha Abeygunasekera, the Quiz Master took over, explaining the format of the quiz, rules and the scoring system. The teams were then invited to participate in the first round, and the quiz commenced. Dr. Himansu Waidyasekera, Senior Lecturer, University of Sri Jayewardenepura, who was the chairperson of the quiz committee, projected the questions, which were also read out by the Quiz Master.

Three senior academics, not representing the Universities of the contestants, functioned as judges to facilitate the Quiz Master on deciding whether the answer is correct or not. Each session had different judges depending on the contesting teams. The team of judges included Prof. Vajira Weerasinghe

(Peradeniya), Prof. K. Sivapalan (Jaffna), Prof. Piyusha Attapattu (Colombo), Dr. Indu Nanayakkara (Peradeniya), Prof. K G Somasiri (Ruhuna), Dr. Lakmali Amarasiri, Prof. Deepthi De Silva (Kelaniya) and Prof. Susirith Mendis (KDU). Scores were maintained by two scorers Dr. Tania Warnakulasooriya (Kelaniya), Dr. Damsara Nandadewa (Peradeniya) and by judges independently. At the end of each session, both scores were crosschecked and announced. Dr. Dulani Kottahachchi, Secretary PSSL, and Dr. Sudarshani Wasalathanthri assisted the Quiz Master.

The first round had 4 sessions where all 8 faculties participated in two teams at a time. The four winners and the highest two scoring teams were selected to compete in the second round. Students from Faculty of Medical Sciences, University of Sri Jayewardenepura performed a song during the break. In the second round, altogether 6 teams participated, in two groups of three at a time. 5 teams scored equal marks and a tie breaker question round was held and highest scoring three teams were selected to compete in the final round. After the finalists were selected there was a break in the programme for lunch.

The finals were held after lunch and the teams from the universities of Colombo, Sri Jayewardenepura and Kelaniya participated in the final round. Contestants had to face high calibre questions at this final round. At the end of the final round the team from the Faculty of Medical Sciences, University of Sri Jayewardenepura emerged as winners of the Quiz, with the teams from Colombo and Kelaniya Medical Faculties being the joint first runners up.

We were privileged to have Prof. Carlo Fonseka, to grace the awards ceremony. Prof. Fonseka addressed the gathering with a thought-provoking and interesting speech. A token of appreciation was presented to the Quiz Master to acknowledge his services. Members of all teams were given certificates of participation and winners received certificates and cash awards (Rs. 15,000/= each for the joint 1st runners-up) from the President of PSSL Prof. Priyadarshika Hettiarachchi. Prof. Carlo Fonseka awarded the winning teams their certificates and cash awards (Rs. 20,000/= for the Champions). The Prof. Carlo Fonseka Challenge Trophy was awarded to the winners of the 5th Inter-Medical Faculty Physiology Quiz.

The program concluded with the vote of thanks by Dr. Dulani Kottahachchi, Secretary PSSL. Thus a yet another successful Inter-Medical Faculty Physiology Quiz for Prof. Carlo Fonseka Challenge Trophy concluded.

The Quiz master in action




Teams in action

Judges in action

Winners of Prof. Carlo Fonseka Challenge Trophy

Quiz team of University of Sri Jayewardenepura

Quiz team of University of Colombo

Joint Runners-up of Prof. Carlo Fonseka Challenge Trophy

Quiz team of University of Kelaniya

Joint Runners-up Prof. Carlo Fonseka Challenge Trophy

16th Annual Inter Medical School Physiology Quiz 2018 - Kuala Lampur, Malaysia

The 16th annual Inter Medical School Physiology Quiz (IMSPQ) was held in Kuala Lampur, Malaysia on 15th - 16th of August 2018. 101 teams from 24 countries participated in this event. The teams from faculties of medicine from the Universities of Colombo, Sri Jayewardenepura, Ruhuna, Jaffna and Kelaniya participated. Each team consisted of 5 undergraduate medical students while the University of Jaffna was represented by a three-member team.

The first event of the competition was the written test, which was held in the morning of August 15th. All members of the teams sat for the written test. The exam comprised of 100 true or false questions in Physiology, which were to be answered in 75-minutes. Incorrect answers were penalized 1 mark. The average scores for each team were calculated. The top 48 teams with the best marks proceeded into the live oral quiz rounds. The names of the 48 qualifying teams were announced during the Cultural Event in the evening. All Sri Lankan teams qualified for the oral quiz which was held the following day 16th August.

Cultural item performed by University of Sri Jayewardenepura

The cultural event started at 7.00 pm on August 15th. 14 out of the 24 participating countries performed cultural items at this event. The Universities of Sri Jayewardenepura and Kelaniya both performed one item each, at this event.

The cultural item performed by the University of Sri Jayewardenepura (USJP) was a traditional dance with a modern touch. Both Kandiyan and Baratha forms of dance were included. The item was very well received by the international audience.

The Oral quiz round was held on 16th August. The top scoring 48 teams were divided into 8 groups with 6 teams per group. In the first round the highest scoring team from each group directly advanced into the quarter finals. After the completion of the first round, the 8 highest scoring teams that did not win their respective rounds were selected, and they too entered the quarter finals. Thus a total of 16 teams entered the quarter finals.

Three members of each team participated in each round of the oral quiz. The composition of each of these 3 member teams could only be changed at the beginning of each subsequent round. The 5 universities against which USJP competed in the first round were Can Tho University of Medicine and Pharmacy, Vietnam, Kaohsiung Medical University, Taiwan, University of Malaya, Malaysia, University of Santo Tomas, Philippines and Sichuan University, China. The USJP team emerged the winners in their group of 6 teams and advanced into the quarter finals. In addition, from Sri Lanka,

Universities of Colombo and Jaffna also qualified for the quarter finals.

Following the first round, the names of the top 10 individuals who scored the highest marks in the written test were announced, and prizes were awarded. Niranjana Uma Rajakanthan from USJP received the prize for 5th highest mark scored in the written test and was the only Sri Lankan to emerge in the top 10 prize winners. The USJP team were placed 5th in the written test (highest rank out of all Sri Lankan teams). Further in the written test the team from University of Jaffna was placed 8th and the team from University of Colombo emerged 11th.

The Quarter Finals

The Quarter Finals were held in the afternoon of the 16th. USJP competed against Siriraj Hospital, Mahidol University, Thailand, Central South University, China and University of Jaffna. USJP did not qualify for the semi-finals. The University of Jaffna was the only Sri Lankan team to qualify for the semi-finals, however at the semi-finals they were not able to qualify for the finals, and received 4th place overall.

The finalists at the event were Chulalongkorn University from Thailand, the First Military Medical University from China and the University of Sydney. The team from Chulalongkorn University, Thailand emerged the champions at the event.

Overall, representing Sri Lanka as a team at the event was a wonderful learning experience for the students. In addition to gaining further knowledge and insight in Physiology they were also able to interact with and observe medical students from several other countries, as well as forming closer friendships were formed with students from other universities in our own country and internationally. During this shared experience of an international quiz bonded all together.

Achievements of Sri Lankan teams participating at the 16th IMSPQ in Malaysia

- All the participating teams from Sri Lanka qualified for the oral rounds of the quiz. Only 48 top scoring teams at the written examination were selected out of 100 medical schools) Therefore, Sri Lankan success rate is 100%.
- Ms. Niranjana Uma Rajakanthan – representing the team from Faculty of Medical Sciences, University of Sri Jayewardenepura was the candidate obtaining the highest score at the written examination from Sri Lanka obtaining 5th place overall.
- The team from Faculty of Medicine, University of Ruhuna was selected as the 'Best new Team ''. The students of the group were, HGGI Manthika, AHAP Bagya, Amanda Prasadini and RMYJ Rathnayake.
- The team from the Faculty of Medicine, University of Colombo qualified up to the quarterfinals of the competition.
- The team from the Faculty of Medicine, University of Jaffna qualified up to the semi-finals of the competition and was placed 4th overall this year.

16th IMSPQ in Malaysia

Niranjana receiving the prize from Prof. Cheng Hwee Ming for scoring the 5th highest marks in the written test

Team of University of Sri Jayewardenepura with Prof. Cheng Hwee Ming

All members of Sri Lankan University teams with Prof. Cheng Hwee Ming and Dr. Kumar Selvakumaran

Physical Activity for Healthy Bones

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Karapitiya, Galle.

Introduction:

Progressive loss of bone mass and micro-architectural deterioration of bone tissue resulting in reduced bone strength leads to osteoporosis. It consequently increases the risk of fragility fracture in older adults with predominant female occurrence. Fragility fractures or minimal trauma fractures are the fractures caused by a fall less than the standing height. Out of the fragility fractures, hip fracture is the most predominant type, associated with increased morbidity, mortality and impaired quality of life, leading to huge healthcare burden. With the increasing older population, especially in Asian countries, fragility fracture risk has been identified as an emerging global health concern.

The important risk factors for sustaining fragility fractures are low bone mass and unfavorable bone structure, both of which independently contribute to low bone strength. Life style modifications applied to increase the bone strength aiming to reduce the fragility fracture risk include increasing the regular physical activity (PA), increasing the calcium intake, and decreasing the risk factors such as smoking and alcohol. This article summarizes the applicability of greater PA to reduce the fracture risk.

Bone mass and bone strength:

Bone is a dynamically and metabolically active tissue that is continuously subjected to bone formation and resorption. These two processes together are called bone remodeling, which occurs on the surfaces of bones, allowing continuous removal and replacement of bone tissue by coordinated action of osteoclasts and osteoblasts. Bone remodeling mainly occurs in the trabecular bone and the process is important to adjust the bone in response to mechanical stress such as exercise, and to repair any micro-damages, consequently readjusting the bone strength. As Harold Frost describes in his "mechanostat theory", local deformation of bone tissue by mechanical loading stimulates the bone cells for bone adaptation. Mechanical loading on bone improves the bone mass and bone strength through a mechanism called "mechanotransduction". Mechanical strain, detected by osteocytes, is transmitted to the effector cells, osteoblasts or osteoclasts, for bone remodeling in response to mechanical stimuli.

During the first two to three decades of life, bone formation predominates over bone resorption increasing of bone mass until the peak bone mass (PBM) is achieved. The rate of bone mineral accrual peaks with the onset of pubertal growth spurt and 26% of the adult total body bone mass is accrued within the two-year period with peak bone mineral velocity. That period is usually considered a window of opportunity to achieve an exercise induced higher peak in bone mass. [1] Furthermore, around 39% of the adult total body and the lumbar spine bone mineral accrual is also achieved during the four peri-pubertal years. Literature highlights the importance of both peak bone mineral accrual and PBM to maintain a higher bone mass in

the elderly, because around 50% of bone mass at age of 70 is estimated to be predicted by PBM and a 10% increase in the PBM could delay the development of osteoporosis by 13 years. After reaching PBM there is a state of equilibrium in which the rate of bone formation equals the rate of bone resorption and thereafter, bone resorption predominates over formation. Postmenopausal women and elderly men decrease the BMD in a rate of 2-5% per year and they are at a risk of developing osteoporosis and fragility fractures.

Fragility fracture prevention:

Improvement of bone mass by restoring bone loss in adults through medication is an expensive fracture preventive strategy that is widely used after identifying high risk individuals for fracture. Regular PA at any age is a key in preventing osteoporosis and reducing fracture risk. Weight bearing activity (WBA) directly improves bone strength whereas resistance exercise indirectly improves bone strength by increasing muscle mass, muscle strength and balance.

Exercise in children and adolescents:

Regular high impact WBA at any age is the type of PA with the greatest influence on the skeleton. However, the effects of PA on bone strength appear greatest around pre-pubertal and early peri-pubertal periods when the bone mineral accrual takes place at its' peak rate. Bone surface-specific changes also become apparent during pubertal growth spurt to influence the bone structure. The exercise effects of higher periosteal apposition in boys and higher endosteal apposition in girls become apparent when exercise training is applied around pubertal growth spurt. Even after the attenuation of rate of bone mineral accrual with achievement of PBM, bone size continuously increases into adult hood by the process of periosteal apposition, which is an important bone structural adaptation benefit for fracture resistance.

Several types of high impact short duration PAs in dynamic nature, including skipping, hopping, jumping and tumbling are found to be associated with beneficial bone health outcomes in children and adolescents with strong evidence. In addition, high impact weight bearing exercise training, or sports with force generating work against gravity or ground reaction forces apply higher mechanical stress on the human skeleton. Examples are volleyball, basketball, martial arts and gymnastics, which support in maintaining greater bone health benefits in children and young adults. The combination of such WBAs with high intake of calcium, significantly improves bone mass in children, justifying that the combination of PA with high calcium intake should be encouraged during pre and peri-pubertal years as an osteoporosis prophylaxis.

Exercise in elderly:

PA in elderly has a little effect on increasing the bone strength by reducing endosteal bone resorption. However, the positive relationship between PA and improvement of physical function in older adults is important for their functional ability, improving balance and reducing the incidence of falls and fall related injuries, including fragility fractures is also provided with strong evidence.

The combinations of PA such as progressive resistance training, yoga, Tai Chi and dancing are important to improve functional ability such as balance, gait speed, muscle strength and activities of daily living in older adults. In elderly, more than one type of PA should be included from each of aerobics, muscle strengthening and balance training.

Evidence for exercise benefits on bone are further strengthened by several recently published systematic reviews and meta-analysis of RCTs of exercise programs and position statements, focused on children and adolescents. [2] Such publications reported that high impact, dynamic, short duration PAs significantly increase bone mass and bone structure aiming better bone health. [3] In addition, regular PA or exercise in older adults is mainly important to preserve physical function and mobility by strengthening muscle and balance to reduce the risk of falls and fall related injuries. [4]

In conclusion, regular physical activities particularly weight bearing PA is a cheap, joyful modifiable life style factor that has a potential influence to improve bone and muscle strength, which reduce the lifetime risk of fragility fractures.

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Cardiopulmonary Exercise Testing - A Novel Method of Clinical Assessment

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Test of Cardiopulmonary function (CPET) during exercise has been used for over 50 years. However, its versatility and clinical use for patients with cardiovascular and pulmonary disease has emerged only recently. The clinical use of CPET has been enhanced further with the development of technology over the years. The addition of ventilatory gas exchange measurements during exercise testing provides a wide array of unique, clinically useful information that had been poorly utilized by the practicing clinician. Therefore, CPET is now being recognised as a valuable testing method that can provide important results for patients with cardiovascular and pulmonary disease. This brief overview would provide the physiological basis for functional exercise testing, methodological considerations, and some of its clinical applications.

CPET has long been used in the assessment of athletic performance. In sports medicine research it provides valuable inputs to trainers and sports personnel as an effective test of endurance. Now, CPET offers the clinician the ability to obtain a wealth of information beyond standard exercise electrocardiography test. Thus, when appropriately used, it can assist in the management of complex cardiovascular diseases, pulmonary diseases and other disorders.

During exercise, the cardiovascular system and the respiratory system function optimally to provide O_2 to the tissues and remove the CO_2 that is produced by the tissues. The CPET provides an assessment of the integrative responses of the cardiovascular, pulmonary, haematopoietic, neuropsychological, and skeletal muscle systems during exercise. It is a low risk, non-invasive test that measures the coordinated function of the above organ systems during an exercise protocol. Further, it allows accurate, dynamic assessment of cardiac and pulmonary performance during exercise in a variety of settings. In the process of measuring dynamic gas exchange during graded exercise, CPET can identify potential deficiencies within these systems. These deficits are often not seen when the resting cardiac and pulmonary functions are assessed.

Modern CPET systems allow for the analysis of gas exchange at rest, during exercise, and during recovery and provide breath-by-breath measures of oxygen uptake ($\dot{V}O_2$), carbon dioxide output ($\dot{V}CO_2$), and ventilation ($\dot{V}E$). These advanced computerized systems provide both simple and complex analysis of data that are easy to retrieve and store. The data can be integrated with standard variables measured during exercise testing, such as heart rate, blood pressure, work rate, and electrocardiography findings. The above data when combined with the patient's symptoms, provide a comprehensive assessment of exercise tolerance and exercise responses. CPET can even be performed with simultaneous imaging investigations to further the diagnostic assessment. Thus, its use and versatility as an investigation tool is now further enhanced to meet the clinical needs.

The variables that can be assessed during CPET testing are many. It includes cardiovascular, pulmonary and metabolic variables. The test is useful as the subject has to undergo only one test to obtain a very broad overview of the function of the cardiovascular and respiratory system functioning together in this setting.

Gas Exchange Physiology in Health and Disease

The ability to perform physical exercise is critically related to the cardiovascular system's ability to supply oxygen (O_2) to the muscles and the respiratory system's ability to remove the carbon dioxide (CO_2) formed by the tissues. Both O_2 and CO_2 are transported along the blood stream and delivered to the lungs. Several processes are essential for the above mechanisms to happen, such as adequate pulmonary ventilation, efficient diffusion of gases at the alveolar capillary membrane, carriage of oxygenated blood to the tissues and removal of tissue CO_2, the exchange of gases at the tissue level. The above processes require both external and internal respiration to function effectively.

As CPET investigates the mechanisms responsible for external and internal respiration by exercise, it frequently reveals abnormalities that are not usually apparent at rest. The increase in oxygen uptake by the working muscles is provided mostly by an increase in cardiac output, which may increase up to 6 times than at rest. The blood flow is redistributed away from non - active tissues (eg. splanchnic and renal) to the skeletal muscles, which further facilitates greater O_2 delivery. In the lungs, the blood flow increases by an increase in the right ventricular output and by vasodilation of the pulmonary vessels. At the muscle level, the tissues extract a greater amount of O_2 from the blood, resulting in a widening of the arteriovenous oxygen (a – v O_2) difference. The respiratory system also increases its work by several methods. Among normal subjects, minute ventilation ($\dot{V}E$) increases in proportion to the increase in work rate initially. During inspiration only part of the tidal volume of air reaches the alveoli, to be involved in gas exchange. During exercise, the 'ventilatory dead space'(VD), (ie. the air that remains in the respiratory passages not participating in gas exchange) too is increased due to dilatation of respiratory passages. However, the increase in the tidal volume maintains adequate alveolar ventilation, and facilitates gas exchange to establish a well matched normal ventilation-perfusion ratio.

Many disease states can alter the matching of ventilation to perfusion. In many forms of pulmonary disease, a higher than normal dead space limits the exercise capacity. This occurs due to a decrease in the healthy lung tissue that can be involved in gas exchange. The increase in $\dot{V}E$ during exercise must be matched by an increase in blood flow; that is, cardiac output must increase to match ventilation to maintain necessary gas exchange.

One of the hallmarks of chronic heart failure is an impaired cardiac output in response to exercise; this may lead to a mismatching of ventilation to perfusion, in which ventilation must increase disproportionately to the metabolic needs to compensate for inadequate perfusion. The degree to which ventilation is abnormally increased during exercise is directly related to the severity of disease and is a strong marker of prognosis.

Assessment of exercise capacity is typically performed on a motorized treadmill or a stationary cycle ergometer. Treadmill exercise is generally the preferred modality in many exercise laboratories. An untrained subject

will usually terminate cycle exercise because of quadriceps fatigue at a $\dot{V}O2$ that is on average 10% - 20% below their treadmill peak $\dot{V}O_2$. Cycle ergometry also requires subject cooperation in maintaining a pedal speed at the desired level, usually about 60 rpm. However most modern ergometers have electronic braking apparatus to maintain a steady work rate at variable speeds. Cycle ergometry is often the preferred mode with subjects having a gait or balance instability, severe obesity, or orthopedic limitations or when simultaneous cardiac imaging is planned. Many types of protocols are used in various settings however the protocol should be tailored to produce a fatigue-limited exercise duration of 8 to 12 minutes.

A final CPET report should include; the reason for the test and what type of type of test was completed (eg, modality, protocol); summarize the patient's base line data and clinical and physiological responses to exercise (eg, duration, symptoms, reason for stopping); and avoid the use of terms positive or negative. The report should conclude with a list of final impressions or recommendations that concisely and specifically respond to the reason the test was ordered.

Several important variables derived from CPET provide useful diagnostic and prognostic information. *Work rate* is derived in METs (metabolic equivalents); *Metabolic exchange* is derived by Maximum aerobic capacity ($\dot{V}O_2max$), Peak $\dot{V}O_2$, Ventilatory threshold (VT), Respiratory exchange ratio (RER), anaerobic threshold (AT), and blood lactate levels, *Cardiovascular responses* are derived by heart rate changes, blood pressure responses, and Electrocardiographic changes, *Ventilatory responses* are derived by total minute ventilation, breathing pattern, ventilatory reserve, ventilatory timing, pulmonary function tests, and derived variable such as ($\dot{V}$ E/$\dot{V}CO_2$ slope, $\dot{V}$E/MVV), *Peripheral gas exchange* is determined by the variables such as (Cardiac Output, Heart Rate-$\dot{V}O_2$ relationship and oxygen saturation). The above are some the most commonly used parameters in clinical practice.

Maximal Aerobic Capacity; ($\dot{V}O_2max$) or Peak $\dot{V}O_2$,

$\dot{V}O_2max$ is an important measurement as it defines the limits of the cardiopulmonary system. It is defined by the Fick equation as the product of cardiac output and arteriovenous oxygen difference [$C(a\text{-}v)O_2$] at peak exercise. The measurement of $\dot{V}O2max$ implies that the maximal physiological limit of an individual has been reached (ie. *maximal aerobic capacity*). It is used to describe exercise capacity in apparently healthy individuals, when they achieve a maximal physiological response to exercise. In people with compromised cardiac and respiratory function, the peak $\dot{V}O_2$ is assessed instead of the $\dot{V}O_2max$ as the disease prevents them from attaining the maximum aerobic capacity,

Peak Respiratory Exchange Ratio

The respiratory exchange ratio (RER), is defined as the ratio between $\dot{V}CO_2$ and $\dot{V}O_2$. It is obtained exclusively from ventilatory expired gas analysis. It is a very good indicator of subject effort. Achievement of at least 85% of the age-predicted maximal heart rate indicates sufficient subject effort during a CPET. Peak RER is consistent in apparently healthy subjects and all patient populations, and is an accurate and reliable gauge of subject effort.

Anaerobic Threshold

It is also known as the lactate threshold or ventilatory threshold. It indicates the onset of metabolic acidosis by a rise in arterial lactate during exercise. The AT is referred to as the VO_2 at which this change occurs and expressed as a percentage of the predicted value of $\dot{V}O_2$ max.

Integration of CPET test data with exercise-ECG test data provides optimal use of CPET. Electrocardiographic criteria (heart rate dynamics, arrhythmia, ST segment changes, and conduction disease), hemodynamics, and symptoms are all important exercise-related measures that complement and expand on the gas exchange indices. Related modes of assessment used during CPX provide additional diagnostic information. Some of these are the noninvasive determination of cardiac output or flow-volume loops of lung function assessment.

Applications of CPET in clinical sports medicine is useful as it is a reliable noninvasive dynamic investigation of cardiovascular and pulmonary function and muscle metabolism.

CPET can be widely used in clinical settings and a useful adjunct to normal exercise ECG testing. Beat to beat variations in cardiac and pulmonary function by this test enhances its diagnostic value. It is a diagnostic tool for many disorders such as myocardial infarction, cardiac failure, cardiac rhythm abnormalities, asthma, exercise induced broncho-constriction, exertional dyspnea and myopathies. It is useful in the evaluation of patients with unexplained dyspnea, development of the exercise prescription for patients with cardiovascular disease or stroke, assessment of disability in patients with cardiac or pulmonary disease and in preoperative assessment of patients undergoing pulmonary resection or bariatric surgery. CPET can also be used as a substitute for the angiogram on patients who are allergic/ sensitive to the radioactive dye. CPET is widely used in the management of obesity (non-weight control centered obesity management) in many institutes in the world. Its uses in the management of diabetes mellitus are to assess and guide glycemic control, to assess and manage micro and macro-vascular complications of DM. In obstetric practice CPET ($\dot{V}O_2$max) can be used to assess fetal cardiac health.

The implementation of CPET as a clinical investigation should be prioritized to provide this important service facility to Sri Lankan patients. However, implementing CPET requires several factors, such as good quality equipment which are expensive, trained personnel capable of administering the tests and clinicians trained in interpreting the tests. Acceptance of CPET by practicing clinicians as an important investigation in the management of serious cardiopulmonary disease is an essential aspect. In order to achieve these ends the clinical physiologists have an important role in training themselves in the above technique and the clinical interpretation to facilitate better care of patients.

Erratum

The above article was published in the November 2017 edition of the PSSL Newsletter. However, some parts were missing due to an inadvertent error in formatting. Thus, the correct version is published in full in the current August 2018 edition.

Please contact the author if you would like more information about this area via: savithriww@yahoo.com

Upcoming events

- South Asian Association of Physiologists Conference,

  Lahore, Pakistan.

  13th – 15th December 2018

  https://sites2.uol.edu.pk/SAAP-PPSCON2018/?page_id=709

- 9th Federation of Asian and Oceanian of Physiologists Societies Congress (FAOPS2019),

  Kobe, Japan.

  March 28th to 31st, 2019 in Kobe, Japan.

  http://www.nips.ac.jp/faops2019/index.html

Pre-Congress Workshop

Applied Statistics in Medical Research: Regression Analysis

Date: Tuesday 30th October 2018

Time: 9.00 am – 1. 00 pm

Faculty of Medicine, Ragama

Resource person:

Prof. Tharaka Dassanayake,
MBBS, M. Phil. (Sri Lanka), Ph. D. (Australia)
Professor in Neurophysiology,
Department of Physiology, Faculty of Medicine, University of Peradeniya

Programme:

Time	**Topic**
8.30 - 9.00 am	Registration
9.00 – 9.05 am	Welcome address
9.05 – 9. 35 am	An introduction to inferential statistics
9.35 – 10.35 am	Multiple linear regression
10.35- 10.50 am	Tea
10.50 – 1.00 pm	Multiple logistic regression
1.00 – 1.05 pm	Closing remarks

Annual Scientific Sessions - 2018

Inauguration Ceremony and K. N. Seneviratne Oration

Faculty of Medicine, University of Colombo

16th November 2018

Time	
6.00 pm	Ceremonial Procession
6.05 pm	National Anthem
6.10 pm	Lighting of the traditional oil lamp
6.15 pm	Presidential Address Prof. Priyadarshika Hettiarachchi President, PSSL
6.25 pm	Address by the Guest of Honor- Dr. S. D. Jayaratne, Consultant Physician,
6.35 pm	Address by the Chief Guest -Prof. Surangi G. Yasawardene, Dean, Faculty of Medical Sciences, University of Sri Jayewardenepura
6.45 pm	**Presentation of Awards** **Professor K. N. Seneviratne Memorial Research Award - 2018** – Dr. Chanika Alahakoon, Department of Physiology, Faculty of Medicine, University of Peradeniya **Professor K. N. Seneviratne Memorial Award for Physiology** Miss K. A. H. Piyatissa, Faculty of Medicine University of Colombo
6.55 pm	Introduction of the orator – President, PSSL
7.00 pm	**Prof. K. N. Seneviratne Oration** **"Development and failure of human artery"** **Prof. Yoshihiro Ishikawa** **Professor and Chair, Cardiovascular Research Institute, School of Medicine, Yokohama City University, Japan**
7.50 pm	Vote of Thanks - Dr. Dulani Kottahachchi, Secretary PSSL
8.00 pm	Reception

Scientific Sessions – 2018

17th November 2018

Faculty of Medical Sciences, University of Sri Jayewardenepura

8.00 -8.30 am **Registration**

8.30 -9.30 am **Free paper session 1**

9.30 -10.15 am **Professor Valentine Basnayake Oration**
Music as Metaphor in the Practice of Medicine
Prof. Susirith Mendis,
Senior Professor of Physiology, Faculty of Medicine,
General Sir John Kotelawala Defence University

10.15-10.45 am **Tea**

10.45- 11.00 am **Presentation by the recipient of the Prof. K. N. Seneviratne Research Award 2017**

Frequency of micronuclei among persons resident in the vicinity of a mineral sand processing factory in Pulmoddai, Sri Lanka
Dr. Tania Warnakulasooriya
Senior Lecturer, Department of Physiology, Faculty of Medicine,
University of Kelaniya

11.00 -12.30 pm **Symposium – Ageing**
Physiology of Healthy Ageing
Dr. Chandana Hewage
Senior Lecturer, Department of Physiology, Faculty of Medical Sciences,
University of Sri Jayewardenepura

Improving Cognition in Ageing
Prof. Shehan Williams
Department of Psychiatry, Faculty of Medicine, University of Kelaniya

Improving Physical Health in Ageing
Dr. Priyankara Jayawardana, Consultant Physician
De Soysa Maternity Hospital, Colombo.

12.30 -1.00 pm	**Plenary lecture** **Physiology of Happiness** Dr. Piyusha Atapattu *Senior Lecturer, Department of Physiology* *Faculty of Medicine, University of Colombo*
1.00 -2.00 pm	**Lunch**
2.00 -3.00 pm	**Free paper session -2**
3.00 pm – 3.45 pm	**Prof. A. C. E. Koch Oration** **Air and Lungs; in Health and Disease** Prof. Savithri Wimalasekera Department of Physiology, Faculty of Medical Sciences, University of Sri Jayewardenepura.
3.00 -3.45 pm	Awards and conclusion
4.00 - 4.30 pm	**Tea**
4.30 pm	Annual General meeting of PSSL

PSSL REGIONAL MEETING 2018

16TH MARCH 2018 AT CONFERENCE ROOM, FACULTY OF MEDICINE, GALLE

PROGRAMME

8.30 – 9.00 am	Registration	
9.00 – 9.30 am	Welcome address & introduction to Dept. of Physiology	Prof. K.G. Somasiri
9.30 – 10.00 am	Science vs. pseudo-science: where is Physiology?	Prof. K.D. Mahinda
10.00 – 11.00 am	Tea and walk around Dept. of Physiology	
11.00- 12.00pm	Improvised devices in Physiology teaching	Prof. Sampath Gunawardena
12.00- 1.00 pm	Exercise is Medicine	Dr. Himan de Silva Sports unit ,Teaching Hospital, Karapitiya
1.00 pm	Lunch	

Social activities (2 pm onwards)
Visit to Martin Wickramasingha museum, Koggala (15km from Faculty of Medicine)
Boat trip to Madol-Duwa, Koggala River (optional)

Registration fee Rs.1000/-

Please contact Dr.Amaranath Karunanayake on 071 6050048 for registration


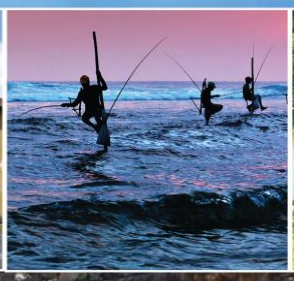
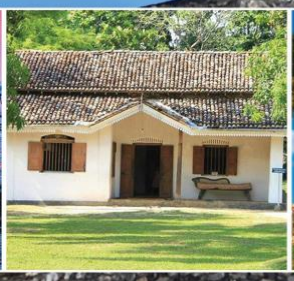
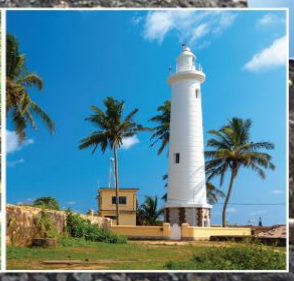

Photo Album of Regional Meeting of PSSL

Achievements

- 2018 IFFGD Research Recognition Award - **Dr. Amaranath Karunanayake, Ph.D., Department of Physiology, Faculty of Medicine, University of Ruhuna** was the recipient of the Developing Nation Investigator award.

  The International Foundation for Functional Gastrointestinal Disorders (IFFGD) is a nonprofit education and research organization dedicated to improving the lives of people affected by gastrointestinal (GI) disorders. Founded in 1991, IFFGD helps improve care by enhancing awareness, improving education, and supporting and encouraging research into treatments and cures for chronic GI conditions.

Dr. Karunanayake with Ceciel Rooker and William Whitehead, Ph.D., with Ceciel Rooker and Marriott Marquis Washington, DC

Newsletter compiled and edited by

Prof. S. W. Wimalasekera

Editor

Physiological Society of Sri Lanka

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