



# The Galle Medical Journal

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## Editorial

### Towards frontiers of human endurance: Evolving role of sports medicine

We are on the verge of the greatest sporting celebration of the world - the Summer Olympics 2020, delayed for one full-year due to the unfortunate COVID-19 pandemic. Sport stretches the physical endurance of men and women to the maximum. The demand on the type and level of endurance varies from sport to sport and within a given sport from event to event.

In their paper on the physiological profile of male long-distance runners and sprinters, Wijayasiri *et al.*, focuses on Sri Lankan athletes of two different types of running events and their cardiopulmonary fitness. Structured exercise and training bring about enhanced performance. The use of unauthorized enhancement medication with the connivance of medical doctors, sport bodies and in some instances states has become a dangerous trend in the world. It is abhorrent from a sporting perspective; unethical from a professional perspective and harmful to health of athletes from a medical perspective.

The discipline of sports medicine has evolved with integration of many facets of care of sportsmen and sportswomen with roles in injury prevention and restoration of function of the injured, so that they can get moving as soon as possible. It also focuses on medical conditions that occur during or following sporting activity. Sports medicine brings together disciplines of internal medicine, emergency medicine, orthopaedics and many others. It also involves inputs from other healthcare professionals as well, *e.g.* physiotherapists, professional trainers, nutritionists etc.

The sports physicians have got to surmount ethical challenges as well. The traditional ethical notions of confidentiality and autonomy are often challenged by multiple stake holders in sport.<sup>1</sup> This undue influence is variable in different situations and often has a pecuniary background.

*Satish K Goonesinghe*

*Eisha I Waidyarathne*

*Editors in Chief/GMJ*

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<sup>1</sup> Greenfield BH, West CR. Ethical issues in sports medicine: a review and justification for ethical decision making and reasoning. *Sports Health*. 2012; 4(6): 475-479

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The mission of the *GMJ* is to promote the science and art of medicine and betterment of public health. The Journal publishes original papers, case reports, leading articles, perspectives and commentaries etc. which have relevance to medicine and allied sciences. The *GMJ* is committed to maintaining and conforming to the editorial and ethical standards recommended by the International Committee of Medical Journal Editors.

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The *Galle Medical Journal* is published by the Galle Medical Association. The *Journal* is published quarterly in March, June, September and December each year. Submissions are accepted throughout the year. The aims of the journal are to foster co-operation among the medical fraternity and to be a forum to make literary contributions, share experiences encountered in medical practice, update their knowledge and have debates on topics related to all aspects of medicine. Also, we attempt to cater to the educational needs especially of the postgraduate trainees. The *Journal* publishes original articles, reviews, leading articles and case reports. When an article is submitted for publication, we expect that the work it reports has not been published, submitted simultaneously to another journal or accepted for publication elsewhere. All manuscripts will be reviewed anonymously before acceptance.

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These should conform to the Vancouver style. The reference in the text should be numbered consecutively in Arabic numerals in parentheses in the same line of the text in the order in which they appear. The first five authors should be listed and if there are more than five, then the first three should be listed followed by *et al*. Examples are given below:

1. Kumar A, Patton DJ, Friedrich MG. The emerging clinical role of cardiovascular magnetic resonance imaging. *Canadian Journal of Cardiology*. 2010; **26**(6): 313-22.
2. Calenoff L, Rogers L. Esophageal complication of surgery and lifesaving procedures. In: Meyers M, Ghahremani G, eds. *Iatrogenic Gastrointestinal Complications*. New York: Springer, 1981: 23-63.

Website references too should conform to the defined Vancouver referencing format;

e.g.: Diabetes Australia. Diabetes globally [Internet]. Canberra ACT: Diabetes Australia; 2012 [updated 2012 Jun 15; cited 2019 Nov 5]. Available from: <http://www.diabetesaustralia.com.au/en/Understanding-Diabetes/Diabetes-Globally/>.

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# Compromising patient safety: Lessons learnt from some critical incidents

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## SUMMARY

During my professional career as a clinician for nearly five decades, I have come across several instances where I felt that my role as a clinician has been a failure. I consider these instances as critical incidents that have molded my clinical practice and hopefully made me a better clinician. In this paper, I will discuss about few of those situations, narrating the experience that I lived through, highlighting where I think I went wrong and how best we clinicians should perform under such circumstances.

I have divided the paper into lapses in history taking, lack of completeness in physical examination, premature closure in making a diagnosis and inadequacies in treatment, and each of these will be illustrated using a real-life scenario that I have lived through. As clinicians, we should strive for zero error, but we human beings are imperfect and often have room for improvement in the ways we act and react. In your clinical practice, irrespective of whether you experience critical incidents or not, it is always better to reflect how you could have treated each patient you have seen, better and make your practice more reflective rather than thinking in a stereotyped manner.

**Key words:** *Metacognition, patient safety, reflective practice.*

*'Value of experiencing is seeing not in seeing much, but in seeing wisely'*

*- Sir William Osler*

### **Critical incidents: What it means to a clinician?**

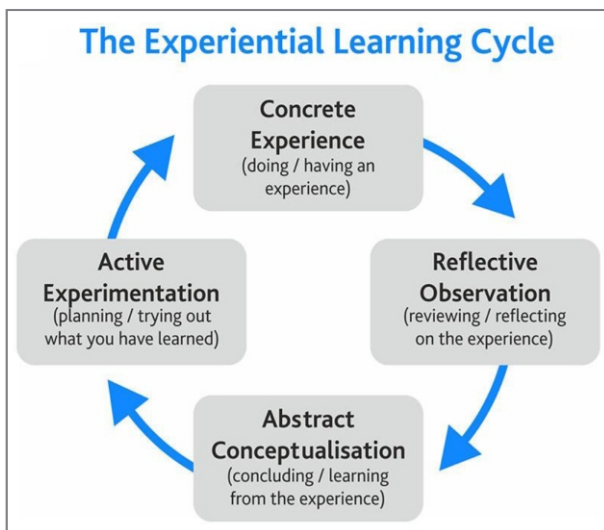
A critical incident from the clinician's perspective is a clinical event where he or she thinks that something was wrong with the diagnosis and/ or subsequent management, inclusive of holistic care (1). Critical incidents are a part of clinician's clinical experience. These are travails and challenges of being a doctor. These incidents are disturbing to the conscientious clinicians. They should self-reflect on these incidents and go further to share these experiences with colleagues. It is a good habit to share lessons that we learn, with our colleagues so that they too will not fall into similar traps.

Critical incidents are clinical events that are also of educational value, influencing personal and professional development of doctors. Therefore, I shall share some of my bad experiences as a clinician to invoke and encourage a habit of self-reflection among the readers with regards to failures they may have endured when delivering clinical care.

### **Role of metacognition**

Self-reflection is a metacognitive process (thinking about one's own thinking) which may also be defined as 'those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to a new understanding and appreciation' (2).

Such new levels of understanding can be achieved by having an experience, then thinking about strengths and weakness and thereby learning from the experience, paving way to perform better the next time. This concept shown in Figure 1 is called Kolb's Experiential Cycle Learning Model (3). As each reflective cycle takes the performer to a higher level of performance each time, repetitive cycles can be considered to be an upward spiral taking the performer from an amateur level to an expert level.



**Figure 1:** Kolb's Experiential Cycle Learning Model (Ref3)

### Sharing the experience

During my professional career as a clinician for nearly five decades, I have come across several instances where I felt that my role as a clinician has been a failure. I consider these instances as critical incidents that have molded my clinical practice and hopefully made me a better clinician. In this account, I will discuss about few of those situations, narrating the experience that I lived through, highlighting where I think I went wrong and how best we clinicians should perform under such circumstances. I have divided this account to lapses in history taking, lack of completeness in physical examination, premature closure in making a diagnosis and inadequacies in treatment and each of these will be illustrated using a real-life

scenario that I have lived through. These mishaps have haunted my mind making me reflect as to how I should do better, and hopefully it has helped me to become a better clinician. I hope this account will help young clinicians to make them better.

### Scenario 1

The first patient that I am discussing was seen by me in 1974 as a post-intern doctor in Kegalle hospital which then was a Base Hospital. She was an unmarried woman about 20 years of age. When I saw her for the first time, she was in a medical ward with a rash on the face. Prior to that she has been admitted several times to the same ward with the same complaint. She mentioned that the rash regularly erupts on the face and that doctors have not told why she is getting the rash. You may have already made a diagnosis. Is it SLE? Is it endometriosis?

On detailed history taking, the Consultant Physician elicited that the rash coincides with her menstrual periods and she gets it only on the face. On further inquiry, she said she has severe dysmenorrhoea which is relieved by paracetamol and as her menstrual flow subsides a facial rash erupts. What would be your diagnosis, now? It is a fixed drug eruption due to paracetamol allergy.

This case illustrates that the diagnosis can be easily missed if attention to detail is not paid during history taking. It is important to probe into details contextually, with an aim of arriving at the diagnosis. Doctors rarely have patience to listen to the whole story and they often interrupt the patient within a minute (4). We need to remember that if we are not good listeners, it will be hard for us to become good doctors.

### Scenario 2

This patient is a teenage girl that I saw in 1980 as a Medical Registrar, in Newcastle, England. She had several hospital admissions for recurrent bouts of haematemesis. I saw some fresh blood in her mouth, on few occasions. She did not give a history suggestive of peptic ulcer, or a history of taking alcohol or NSAIDs. She looked well and did not



seem to be too concerned. Physical examination and several upper GI endoscopies were normal. We were unable to arrive at a diagnosis.

When you are faced with a diagnostic dilemma it is good to take a step back and revisit basics. We need to remember that blood that get coughed-up (haemoptysis) or blood that drips down from the nasopharynx (epistaxis) due to nasal or nasopharyngeal pathology can masquerade as haematemesis. She was not a smoker and she did not give a history of cough and her chest radiograph was normal - effectively ruling out any lung pathology. Despite negative findings she was treated with cimetidine which is a H2-receptor blocker which was the drug of choice for peptic ulceration, 40 years ago.

Then the patient was referred to the ENT surgeon who wrote back: *“There are multiple bite marks on inner aspects of both cheeks. Nasal cavity, pharynx and larynx are normal”*. She was diagnosed to have Munchausen syndrome (5). She was referred to the Psychiatrist. Patient faked haematemesis by biting the buccal aspects of her cheeks and manipulated her doctors

In a situation like this lateral thinking (thinking outside the box) can be useful. Lateral thinking, as opposed to tunnel vision is a good skill to be developed by clinicians. When in doubt, always question yourself as to whether you are correct. Often, rather than revising the diagnosis and admit that the conclusion is wrong, the tendency is to show that we are always correct, and we start looking for evidence to justify our foregone wrong conclusion. This is poor clinical reasoning, and it should be avoided. It can lead to unwarranted mortality and morbidity besides wasting time, energy and money. We need to lead by example and learn to admit we can sometimes be wrong and be prepared to be flexible. It is always good to entertain a differential diagnosis rather than be dogmatic. As we become senior in service there is a tendency to develop fixed ideas and being not receptive to others, including junior colleagues and patients. We need to remember that clinical medicine should be practiced as an art as well as a science and be mindful that it evolves with advancement of science.

### Scenario 3

This patient was admitted as an emergency to the medical ward of Teaching Hospital, Karapitiya, Galle in 1997. As the Physician-on-call, I was called to see this young man who looked very ill and we learned that he had been in good health before he fell from a coconut tree 3 days ago. During the fall he had sustained few bruises in his chest but had not lost consciousness or sustained any head injuries. As he had chest pain, he visited a doctor in his village soon after the fall, and he was reassured and sent home on pain killers.

He was tachycardic, tachypnoeic, hypotensive with very high fever. Breath sounds were absent, and the percussion note was stony dull on the left side. Chest radiograph taken at the time of admission showed features suggestive of a left sided hydropneumothorax. As the patient was extremely breathless, we swiftly inserted an intercostal drainage tube to relieve the hydropneumothorax and evacuated few hundred milliliters of turbid, foetid fluid with fine particulate matter.

Our surgical colleagues who were consulted wanted the patient to be sent to the operating theatre for immediate surgery for treatment of a condition we had missed. They suspected a traumatic diaphragmatic hernia on the left side resulting herniation of the stomach and intestine with subsequent strangulation and perforation. As there was extensive intestinal gangrene which has resulted in septic shock, patient succumbed in the operating theatre.

In retrospect we found multiple rib fractures and few small fluid levels in addition to the large fluid level that we had noted earlier on the left side in the chest radiograph. The main reason for missing the diagnosis was our lackadaisical approach of just holding the radiograph against ambient light and reading it. The other reason for missing the diagnosis was framing of our thoughts to fit a preconceived diagnosis (a bottoms-up approach) – of a medical condition disregarding the history of trauma as the patient was seen in a medical ward with high fever, dyspnoea and signs of fluid in the chest. This type of clinical reasoning can be considered a cognitive bias leading to confirmation bias with goal directed behaviour - a failed attempt at

pattern recognition. As a clinician gains experience, he or she tends to rely more and more on 'pattern recognition' to arrive at a diagnosis (6). In challenging clinical encounters, even experienced clinicians may have resort to 'hypothetico-deductive' approach in clinical reasoning.

#### Scenario 4

A middle-aged woman with bronchial asthma was seen around mid-1990s as a Physician in the out-patient clinic. As she had to take metered dose inhaler (MDI) several times at night, I started her on a regular steroid MDI and reviewed her two weeks later. During the review visit, as her asthma was not under control, I wanted first to check her compliance, before escalating her treatment. When she was asked to demonstrate the inhalation technique, she triggered the MDI without taking the cap off. Then I told her to trigger it after taking the cap off, but she could not do it. When I tried to take off the cap, I had to struggle as the cap was stuck to the MDI with the spray that has collected and condensed from within under the cap, with no medication being delivered to her all along.

As you would realize, the patient has not received any benefit from the steroid MDI. Who should be blamed for this error? Doctor, pharmacist or patient? Of course, I am ready to take the full blame. Often doctors scribble some medications on the prescription pad and tear off the page and just give it to the patient and tell 'take these medicines' - in Sinhala 'mei beheth tika bonna'. This practice should be deplored, and it demonstrates a huge gap in communication. The better practice for prescription of medications would be to (7): 1) explain what condition you are treating, for how long, how often medications need to be taken and how it should be taken, 2) find out about any drug allergies and avoid offending drugs, and in case an allergy develops that all medications be stopped followed by a quick visit to the doctor, 3) check whether the patient is already on any other medications including over-the-counter medications and traditional medicines, 4) wrap up by checking whether the patient understood and whether he or she needs any clarifications and to tell her when to come back. 5) In special situations,

like when prescribing inhalers demonstrate how devices can be used with or without the help of pharmacists.

#### Conclusions

As clinicians, we should strive for zero error, but we humans being are imperfect and often have room for improvement in the ways we act and react. In your clinical practice, irrespective of whether you experience critical incidents or not, it is always better to reflect how you could have treated each patient you have seen better and make your practice more reflective rather than thinking in a stereotyped manner.

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# Save the children from screen overuse

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## Introduction

There has been a marked increase in the use of screen-based devices over the last decade. Screen-based devices are electronic devices with a screen that is used to visualise digital images or videos. Traditional screen-based devices are televisions and computers while the newer versions are smartphones, tablets, and *iPads*<sup>TM</sup>. Now more than ever, children, irrespective of their age have unlimited access to a wide variety of screen-based devices. They spend lots of time engaged in screen-based activities, such as interacting on social media, playing video games, and surfing the Internet.

The screen-based media (SBM) have a strong influence on children, falling into their immediate social environment at present. Confinement of children into homes during the recent COVID-19 pandemic resulted in the escalation of screen use time. SBM has a positive impact on children today as it helps as a practical way to continue their education from home. However, there are growing concerns about the negative impact of SBM on children. Hence, parents should be aware of the harmful effects of screen overuse to prevent their children from screen overuse.

This review elaborates on the magnitude, impact, and responsibility of the parents and society regarding screen overuse among children.

## The magnitude of the problem

Screen time is defined as the amount of time someone spends looking at an electronic device with a screen such as a television, computer, or smartphone (1). According to the recommendation

of the American Academy of Paediatrics (AAP) and World Health Organization (WHO), the maximum screen use time allowed for children is two hours per day, and the time allowed for the screen varied with the age of the child (2). There is research evidence to show that children from all parts of the world are exceeding this limit. British adolescents spend 6.1 hours and American children spend 7.5 hours on screens per day (3). Screen overuse is a major issue among Sri Lankan children as well although we have done a limited research on this field. In a hospital-based survey done among 109 children at Lady Ridgeway Hospital for Children, Colombo, Sri Lanka on screen use time, it was found that more than 70% had exceeded two hours AAP limit.

## Impact of screen overuse on children

Children acquire early developmental and functional skills throughout childhood, with zero to five years being the predominant period where these skills are acquired (4).

To have optimal development, children need to grow up in an environment with adequate social, emotional, and educational inputs. Having a safe and loving home and spending time with family and friends, playing, singing, reading, and talking is very important to achieve maximum brain development. Screen overuse can have a negative impact since it results in reduced opportunities for social interaction, reduced chance for active learning and physical activity. The risks of exposure

to violence, sexually explicit content and cultural stereotypes are also matters of concern (4).

Several studies have shown that excessive screen use is negatively related to the psychological and social development of children as this robs the time required for social activities of children (5).

American Psychological Association states a clear connection between aggression and video game violence (6, 7). A study conducted among 1200 students in Kandy, Sri Lanka reported a clear association between changes in behaviour following excessive screen time. Poor attention, violent behaviour, and hyperactivity were the observed behavioural changes (3). Depression and loneliness are also known to associate with internet addiction resulting in social isolation (8).

Furthermore, playing with peers is an important activity for the healthy development of the brain. It improves the problem-solving skills and creativity but also the social and emotional skills like empathy, managing emotions, building healthy relationships. Unfortunately, now children spend less time playing with real friends and spend more time on the screen, playing video games with virtual friends whom they may not have even seen before.

Excess screen use reduces the opportunities for parent-child interactions like shared reading and playing together with toys. Studies have shown that language development is delayed and academic achievements are decreased in children who have fewer parent-child interactions (9). Nowadays parents use screen-based devices, especially smartphones as a pacifier to console their children. Some parents themselves have generous attitudes towards smartphones and use them to entertain their children, especially during feeding.

Finally, children with higher levels of screen use, tend to be having a sedentary life which leads to a high risk of obesity (10). Poor food habits could also be a result of screen use as children tend to eat unhealthy food which is advertised on the television.

Events occurring in the early years of the life of the child are very important for his achievements during the later life. Excessive screen use among children is likely to continue throughout life and this may result in a great loss in their productive life.

### **Responsibility of the parents and the society**

Parents should realise the negative effects of screen overuse on children and efforts should be taken to prevent children from getting addicted to the screen. They can impose some ground rules at home like banning screen devices such as televisions and smartphones in the dining table and bedroom. Parents can be good role models for children. It is the responsibility of the parents to minimise their own screen time and guide their children regarding their screen usage. Parents should not let the television, computer, or smartphone disrupt the parent-child interaction at home. Engaging in playing and quality time with family will aid in the development of essential skills like language, self-regulation, and creativity for children less than 5 years of age (11). Parents should make sure media does not take the place of adequate sleep, physical activity, and other behaviours essential to health.

Healthcare professionals and professional bodies providing social care to children should take a lead in taking this message to the public. The Australian and Canadian governments state that screen viewing time should be limited to less than one hour for children between two to five years (2). WHO also recommend that sedentary screen time for children between the ages of three to four years should not exceed one hour, and also states that lesser sedentary screen time is preferable (12). According to the WHO, screen time is not recommended for infants and toddlers below 18 months, except video chatting with parents or grandparents. Preschoolers (2 - 5 years) and primary schoolers (6 - 10 years) are allowed only for one hour and one and half hours respectively. As children grow up, parents can gradually give kids more control and choice in how they manage their time on the screen. For middle-school-age children (11 - 13 years) the recommended screen time is up to 2 hours per day.

In addition, a society-wide effort is essential to save children from screen overuse. Awareness programmes targeting preschool children and their parents on-screen overuse would be an investment in the future of the nation.

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# Profile of stress among a group of female school children in their early adolescence in the Galle educational zone; a descriptive cross sectional study

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## ABSTRACT

**Introduction:** Age ranging from 11 to 14 years is regarded as early adolescence. Females are particularly vulnerable to experience stress with rapid physical, psychological, cognitive and social changes accompanied in adolescence. Stress experienced in adolescence is linked with a range of adverse physical and psychological consequences. The study aimed to determine the level of stress and factors contributing to stress among female adolescents in the Galle educational zone, Sri Lanka.

**Methods:** A school based cross - sectional study was conducted on female adolescents (11 - 14 years, n = 218). A self-administered socio-demographic questionnaire and psychosocial adversity scale were used to assess socioeconomic status and psychosocial adversities respectively. The Body Mass Index (BMI), waist hip ratio (WHR), waist height ratio (WHtR) and fat percentage (FM%) were calculated to assess the nutritional status. Adolescent Stress Questionnaire (ASQ), which measures 9 dimensions of stress, was used to assess stress.

**Results:** Normal nutritional status was observed in 118 (54.1%) while 65 (29.8%) and 35 (16.1%) adolescents were underweight and overweight respectively. A majority of adolescents (n = 158, 72.9%) were experiencing stress. An increased stress levels were observed for the domains of school attendance (n = 203, 93.1%), future uncertainty (n = 202, 92.7%), school performance (n = 185, 84.9%), emerging responsibility (n = 186, 85.3%), and conflict of school/leisure time (n = 178, 81.7%).

**Conclusions:** Most adolescents considered future uncertainty and school attendance as the greatest stress inducing factors. Urgent measures to decrease stress levels amongst these adolescents need to be implemented.

**Key words:** *Early female adolescents, profile of stress.*

## Introduction

Transition from care dependent childhood to care independent adulthood is adolescence. According to the WHO, age 11 to 14 years is regarded as early adolescence and this period is characterised by significant development in physical, psychological and social domains (1). Generally cortisol level

increases in female adolescents with the onset of puberty due to an elevated level of gonadal hormones (2). Therefore female adolescents are particularly vulnerable for stressors possibly due to interaction between glucocorticoids and gonadal hormones.

Alternatively there are differences between genders in stress hormone activation, in particular female adolescents demonstrate greater stress hormone reactivity compared to male adolescents (3). The brain continues to mature, particularly the subcortical structures of the brain, which are highly involved in emotional and cognitive development that, undergo marked structural and functional changes during the adolescence. Recent human and nonhuman studies have discovered, stress can alter the neural architecture within the corticolimbic regions of developing adolescent brain, thus it could negatively impact on cognitive development and academic outcomes too (4). Therefore, taken together stress experiences in the adolescence lead to greater exposure of the brain to steroid hormones producing long lasting effects on developing brain.

Stress experience in adolescence is more likely to link with a range of adverse physical and psychological consequences such as substance abuse, drug abuse, poisoning, physical inactivity and uncontrolled weight gain. Survey of previous literature revealed that depression and anxiety are more prevalent among female adolescents than male adolescents in Sri Lanka (5, 6). However studies on the factors associated with stress among Asian female adolescents are limited. Considering these facts, the present study was aimed to determine stress profile of female adolescents.

## Methods

**Study population and Design:** A school-based descriptive cross-sectional study was conducted on randomly selected schools in the Galle educational zone in Sri Lanka. Female adolescents aged 11- 14 years (n = 218) residing in the city of Galle were recruited. Schools were randomly selected representing all categories of schools classified by the Ministry of Education. The classes were randomly selected covering age 11 to 14 years. All students in each selected class were recruited.

### Assessment of socioeconomic status and psychosocial adversities

A self-administered socio-demographic questionnaire was used to assess the educational level, employment status and income level of the parents.

Parents' occupation was categorised based on criteria of the Hollingshead Index of Occupation Scale matched as closely as possible to modern occupations (7). Income to need ratio was calculated, by dividing total family income by official poverty threshold for a family of that size. Official poverty threshold published by the department of Census and Statistics, Sri Lanka was applied to calculate income to need ratio. Finally family socioeconomic status (SES) composite score (SES index) was derived by standardizing and averaging income to need ratio, parental education and Hollingshead occupation scale rank.

Psychosocially adverse factors were objectively assessed using the psychosocial adversity scale and this scale has been widely used in child development studies in Asian settings (8). It assesses the home environment and the parent's health status. Psychosocial adversity index (PA index) score was derived summing the total scores. Higher scores indicated higher levels of psychosocial adversity. Items were scored by interviewing the adolescent.

Adolescents' stress was assessed using Adolescence Stress Questionnaire (ASQ) that has been widely used to measure stress of adolescence (9, 10, 11). It has been validated to Sinhala language and showed acceptable internal reliability and construct validity (12). The questionnaire measures nine dimensions of adolescence stress including stress of home life, school performance, school attendance, romantic relationships, peer pressure, teacher interaction, future uncertainty, school/ leisure conflict and emerging adult responsibility. It is a self-administered questionnaire and each item was rated on a 5 point Likert scale where 1 = not at all stressful/ irrelevant to me, 2 = a little stressful, 3 = moderately stressful, 4 = quite stressful and 5 = very stressful. The marks for answers ranked from 1 - 5 score and total score for each component scale were calculated by the counting the scores of the items that belong to the scale. The score more than 3 per each domain was considered as the cut-off level to indicate stress. Adolescents with a total score of more than 156 (out of 250) were categorised into the stressed group.



### Assessment of anthropometric measurements

In order to assess nutritional status of study participants, body mass index (BMI), fat mass percentage (FM%), waist circumference (WC), hip circumference (HC), waist hip ratio (WHR) and waist height ratio (WHtR) were calculated. Height for age z score (HAZ) and weight for age z score (WAZ) were calculated using WHO sex specific growth reference values for adolescents. Triceps and subscapular skin fold thickness were measured using skin fold caliper according to standard protocol and FM% was calculated using a validated FM% estimation equation developed for Sri Lankan children by Wickramasinghe *et al.* (13).

Data were analysed using SPSS 20 version software. Descriptive statistics were used to describe nutritional and psychosocial status characteristics. Independent sample t-test was applied to compare means between stressed and non-stressed groups. P value less than 0.05 was considered as statistically significant. Ethical approval was granted by the Ethics Review Committee, Faculty of Medical Sciences, the University of Sri Jayewardenepura. Informed written consent from the parents and assent of the child were taken prior to the commencement of data collection.

### Results

The age of the study participants ranged from 11 to 14 years with mean age 12.31 ( $\pm 1.16$ ) years. Majority of the participants were Sinhalese by ethnicity and Buddhist by religion. About 49.5 % of adolescents had two or three siblings. Most (57%) of the adolescents had attained menarche by the time of the study. Majority of adolescents (n = 143, 68.3%) were in nuclear families while others were living in extended families. Around half of the study participants (54%) resided in semi urban areas.

Mean BMI of the study sample was 18.22 ( $\pm 4.19$ ). Study participants were categorised into under-weight, normal and overweight groups based on age and sex specific BMI percentile values based on the WHO growth reference values.

Accordingly, 29.8% were underweight among female adolescents, while 54.1% and 16.1% were within normal and overweight categories. Around 35% (n = 77) of female adolescents were centrally obese in this sample. Female adolescents undergo significant physical changes in body fat distribution and muscle mass with the onset of puberty. However there was no statistically significant difference in body fat distribution between post pubertal adolescents and pre pubertal adolescents in this study group ( $p > 0.05$ ).

Majority of the participants (n = 158, 72.5%) belonged to the stressed group whereas others (n = 60, 27.5%) were classified as the non-stressed groups. As the results tabulated in Table 1, age and nutritional parameters were not significantly different between stressed and non-stressed groups. Moreover, socioeconomic index and psychosocial adversity index were also not different between the two groups ( $p > 0.05$ ). This confirms that both groups are similar other than for the level of stress.

The ASQ score ranged from 83 to 208, and the mean stress score of these adolescents was  $145.4 \pm 24.3$ . The factors contributing to stress among female adolescents are summarised in Table 2. Most adolescents reported the stress of future uncertainty (n = 202, 92.7%) and school attendance (n = 203, 93.1%) as the greatest inducing factors. Other important factors responsible for their stress were school performance, emerging responsibilities, conflict between school/ leisure time, romantic relationships, peer pressure and teacher interactions. Pressure from the parents to perform better in school made a considerable contribution (n = 180, 82.5%) to stress associated with school performance. The scores for having too much home work (n = 186, 85.3%), too much expectation by parents from adolescents (n = 185, 84.8%) and not having enough time for leisure activities (n = 178, 81.6%) were significantly higher amongst the stressed group compared to the non-stressed group ( $p < 0.05$  for all).

**Table 1:** Anthropometric measures, SES index score and psychosocial adversity index score among adolescents

Characteristics	Stressed group (n = 158)		Non-stressed group (n = 60)		p value
	Mean	(SD)	Mean	(SD)	
Age	12.3	(1.1)	12.2	(1.1)	0.825
BMI	18.2	(4.1)	18.0	(4.3)	0.763
Fat percentage	21.0	(3.9)	21.2	(4.1)	0.863
Waist circumference	64.0	(8.6)	64.3	(8.5)	0.770
Hip circumference	78.3	(10.2)	77.0	(9.8)	0.393
Waist hip ratio	0.8	(0.05)	0.8	(0.04)	0.200
Waist height ratio	0.43	(0.09)	0.4	(0.05)	0.916
SES index	32.0	(11.8)	30.6	(11.3)	0.465
Psychosocial adversity index	3.0	(2.6)	3.4	(2.6)	0.298

**Table 2:** Level of stress for each dimension in the ASQ experienced among adolescents

Component in the ASQ	Stressful		Non-stressful	
	n	(%)	n	(%)
Stress of - home life	133	(61%)	85	(39%)
- school performance	185	(84.9%)	33	(15.1%)
- school attendance	203	(93.1%)	15	(11.5%)
- romantic relationship	141	(64.7%)	77	(35.3%)
- peer pressure	133	(61%)	85	(39%)
- teacher interaction	131	(60.1%)	87	(39.9%)
- future uncertainty	202	(92.7%)	16	(7.3%)
- school / leisure time	178	(81.7%)	40	(1.3%)
- emerging responsibilities	186	(85.3%)	32	(14.7%)

## Discussion

In this cross sectional study, it was found that an overwhelming number of female adolescents were stressed. This conforms with previous study findings high prevalence of stress among females (9, 11). A cross sectional survey conducted by Rodrigo and colleagues in the Rathnapura municipality

indicate 36% and 28% of school students aged 14-18 years were diagnosed with depression and severe anxiety respectively (6). When considering the global data, it has been revealed that high proportion of female adolescents have experienced stress in India too (14).

In addition, female adolescents exhibited higher perceived stress scores as measured by ASQ among European adolescents (11) and Norwegian adolescents (10). Adolescence is a window period in life which experiences substantial biological changes. The hormonal and physical changes of puberty are a stressful experience for most female adolescents as they have to adapt to the monthly menstruation. Therefore, reserved social life style experienced within the Sri Lankan cultural norms provides more opportunities for vulnerability to stressors.

Studying material with minimum interest and high teacher expectation, pressure of studies, attending school, compulsory school attendance, lack of respect from teachers and disagreement between teachers and student are significant factors contributing to stress among female adolescents in the present study. Rodrigo and colleagues explained examination related issues, difficulty in studying and problems with teachers as the major causative factors inducing depression and anxiety among adolescents. Other studies also observed harsh discipline by parents and teachers and violence observed at home leads to adverse mental health problems (15).

Conversely, not having enough leisure time, recreational activities and having too much homework create unnecessary psychological burden to adolescents. In Sri Lanka, education is provided free of charge to all students attending state schools. The current education system and school curriculum are highly exam-oriented and demand higher memorizing capacity, thus adolescents tend to be stressed within the competitive education environment. Students are confined into homework activities and it restricts their time to play and engage in recreational activities. Parental pressure to perform academically well to secure high scores at examinations and achieve other academic targets, lead to negative mental outcomes and undue stress amongst adolescents.

Academic study is a main possible source of stress of students in other Asian countries too, particularly India, Singapore, China and Korea (16, 17). Asian school aged adolescents tend to have more academic related stress compared to western countries. This difference might be attributed to differences in the two education systems and perceived value of

education. As in Sri Lanka, frequent parental pressure to improve academic success and expectation and peer competition were the leading predisposing factors contributing to depression, anxiety and stress amongst Indian (14) and Chinese (18) adolescents. In addition, tuition class system has now been widely established, well popular and most students and parents have been victims of it. Unlike in the past, students tend to attend to classes to cover all subjects, parents pay high tuition fees in the hope of additional academic output regardless of vacation period.

There was no significant difference in stress of romantic relationship between stressed and non-stressed group in the present study. It is plausible that female adolescents are reluctant to explain their personal issues within the context of social and cultural taboo. However, most of the reported incidences of deliberate self-harm and suicide in adolescents in Sri Lanka are due to the problems related to romantic relationships (6).

Considering all these facts establishment of good teacher student and parent child relationship are important to secure trust and support to overcome anxiety and stress of adolescents. Provision of counselling programme at school and community level would help to ensure better psychological wellbeing. Moreover school authorities could implement parent awareness programmes focussing information on negative impact of parental pressure on academic success, importance of positive response and child friendly parenting style.

## Conclusions

The findings provide clear evidence for the nature and extent of psychological problems encountered by early adolescent girls. It is clear that family, peer and teacher participation is vital in coping with stress. As such it is of paramount importance that school authorities and family members are aware and be responsive to the negative mental health outcomes associated with stress.

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# Physiological profile of Sri Lankan male long distance runners and sprinters competing at national level and university level; a descriptive study

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## ABSTRACT

**Introduction:** Despite regular training Sri Lankan runners do not perform well in international sports arena. The performance of a runner is determined by cardiopulmonary fitness level. However, little is known about the cardiopulmonary fitness levels of Sri Lankan runners. Thus, the present study was conducted to assess the status of the cardiopulmonary fitness of a group of Sri Lankan national level and university level male long distance runners and sprinters.

**Methods:** A descriptive cross-sectional study was conducted to determine the baseline data using interviewer administered questionnaire and clinical examination of 95 male runners [national level long distance runners (n = 27), national level sprinters (n = 27), university level long distance runners (n = 20), university level sprinters (n = 21)] and age and sex matched control subjects (n = 41). Cardiopulmonary exercise fitness was assessed by a fully automated Cardiopulmonary Exercise Testing (CPET) machine.

**Results:** The CPET parameters such as  $VO_{2max}$ , peak workload, exercise duration, heart rate at rest ( $HR_{rest}$ ) and at peak ( $HR_{peak}$ ), systolic blood pressure at rest ( $SBP_{rest}$ ), and at peak ( $SBP_{peak}$ ), diastolic blood pressure at rest ( $DBP_{rest}$ ), and at peak ( $DBP_{peak}$ ) amongst Sri Lankan national level runners indicated minimal improvement when compared to Sri Lankan university level runners. Further, most of the CPET parameters of Sri Lankan runners were lower when compared with those parameters of runners from the Asian region.

**Conclusions and recommendations:** Cardiopulmonary fitness of Sri Lankan long distance runners and sprinters is low. Thus, training protocols are needed to be modified in accordance with the baseline CPET parameters to attain optimal cardiovascular remodelling to enhance the performance of Sri Lankan runners.

**Key words:** *Cardiopulmonary fitness, cardiopulmonary fitness assessment, running athletes, running performance.*

## Introduction

The physical training and exercise promote functional and structural changes in cardiovascular system resulting in physiological modifications desirable for an athlete to give his/ her optimal performance. These changes are collectively known as cardiovascular remodelling. Cardiopulmonary exercise testing (CPET) is a widely accepted mode to determine cardiopulmonary response to training of athletes. Optimal cardiopulmonary fitness of an athlete indicates the integrated ability of the body to transport oxygen from the atmosphere to the mitochondria in muscles and remove the metabolic by-products from the active muscles during high intensity physical activity. Thus CPET parameters are dependent on a linked chain of processes that include pulmonary ventilation, diffusion of gases at the level of lungs and tissues, cardiac autonomic control, functions of the right and left ventricles (during both systole and diastole), the ability of the vasculature to accommodate and efficiently transport blood from the heart to active muscles and the ability of the muscle cells to receive and use the oxygen and nutrients delivered by the blood (1). Thus, CPET parameters comprehensively determine the function of the heart, the circulation and the respiratory system.

Maximal O<sub>2</sub> consumption (VO<sub>2max</sub>) is a main CPET parameter which comprehensively describes the cardiopulmonary fitness level and it can be used to measure the adaptations of the runners to the training. Most important factors that influence the individual differences of VO<sub>2max</sub> are the mode of exercise and the trained state of the body, body composition, heredity, gender, and chronological age (2).

A high VO<sub>2max</sub> is a prerequisite for success in long-distance running performance. Endurance training of male and female runners engaged in long distance running events such as 10,000 m and marathon events, increases VO<sub>2max</sub> by 10% - 25% compared to untrained sedentary people (3). The VO<sub>2max</sub> of some professional marathoners have been reported as nearly as twice of the VO<sub>2max</sub> of sedentary individuals (4). In contrast to endurance training, sprint runners will increase the VO<sub>2max</sub> by 5% - 12% with training, compared to untrained people irrespective of gender (5).

Training results in an enhanced parasympathetic tone over the sympathetic activity on the heart. Thus, regular training results in adaptation of the heart; a major manifestation of the cardiac regulatory mechanisms (6). This effect is more pronounced in athletes engaged in endurance training as indicated by higher reduction in HR<sub>rest</sub> as much as 43% when compared to untrained individuals (7). Well trained elite athletes with high endurance have significantly lower peak heart rates than the untrained individuals at a given VO<sub>2max</sub> (8).

The blood pressure response may be detrimental to the exercise performance of athletes (9). As reported in literature, professional endurance runners have significantly lower resting blood pressure than normal people. Studies report a reduction in mean SBP<sub>rest</sub> by 05mmHg and a reduction in mean DBP<sub>rest</sub> by 03 mmHg after endurance training (10).

Considering the above background, the present study was conducted to assess cardiopulmonary fitness parameters amongst Sri Lankan athletes engaged in long distance running events (10,000 m and marathon) and sprinters (engaged in 100 m and 200 m running) in comparison with age, gender and height-matched controls. Since there is a paucity of CPET data on Sri Lankan runners, these values would be useful to guide training schedules of Sri Lankan runners to enhance their performance to reach international standards.

## Methods

The study group consisted of 95 male runners; National Level Long Distance Runners (NLDR, n = 27), National Level Sprinters (NLS, n = 20), University Level Long Distance Runners (ULDR, n = 27), University Level Sprinters (USR, n = 21). National level runners competing at national and international level and university runners competing at Sri Lanka University Games were recruited into the study. Age, sex and height matched sedentary adults who were not attending in regular sports training were studied as control subjects (n = 41). Those who had past or present history of musculoskeletal injuries or chronic non communicable diseases were excluded from the study.

All participants gave informed written consent. They were assessed using an interviewer administered questionnaire to obtain baseline data and a full clinical examination including resting ECG to confirm general health before start the study. Height and weight were measured for the calculation of body mass index (BMI). Systolic and diastolic blood pressure were measured at rest and just after exercise.

Prior to conducting each test, the CPET machine was calibrated by using the calibration cylinder according manufacturer's guidelines. CPET for the runners and controls was carried out by using continuous incremental protocol (30W/minute) up to exhaustion (11) with electromagnetically braked cycle ergometer (COSMED, Italy). Real time gas analysis was conducted using a fully automated CPET machine (*Fitmate*<sup>TM</sup>, COSMED, Italy). The parameters assessed were  $VO_{2max}$  (ml/kg/min), exercise duration (minutes), exercise capacity (Metabolic Equivalents; METs), work load (W), heart rate at rest ( $HR_{rest}$ ) and at peak ( $HR_{peak}$ ) (beats.min<sup>-1</sup>), systolic blood pressure at rest ( $SBP_{rest}$ ) and at peak ( $SBP_{peak}$ )(mmHg), diastolic blood pressure at rest ( $DBP_{rest}$ ) and at peak ( $DBP_{peak}$ ) (mmHg).

Ethical approval was granted for the study by the Ethics Review Committee of Faculty of Medical Sciences, University of Sri Jayewardenepura.

## Statistical analysis

Data were analysed by using the Statistical Package for the Social Sciences (SPSS) version 20. Data were compared using ANOVA and Student's t-test.

## Results

The mean values of age, height, weight, BMI and duration of training of NLDR, ULDR and controls are summarised in Table 1. The mean weight and mean BMI of male controls was significantly higher than the mean weight and mean BMI of NLDR and ULDR ( $p < 0.05$ ). Even though the duration of training between NLDR and ULDR was similar ( $p > 0.05$ ), NLDR were engaged in significantly higher number of training hours per week than the ULDR ( $p < 0.05$ ).

The mean age, height, weight, BMI and duration of training of NSR, USR and controls are summarised in Table 2. The mean age, height, weight, BMI and duration of training were not significantly different between NSR, USR and controls ( $p > 0.05$ ). The mean training hours per week of NSR was significantly higher than the USR ( $p < 0.05$ ).

CPET parameters of national level runners, university level runners and controls are summarised in Tables 3 and 4.

**Table 1:** Age, anthropometry and training data of national level and university level long distance runners and controls

Baseline Characteristics	NLDR (n = 27) (Mean ± SD)	ULDR (n = 27) (Mean ± SD)	Controls (n = 41) (Mean ± SD)
Age (years)	23.7 ± 4.9	22.8 ± 1.3	23.0 ± 1.4
Height (cm)	168.0 ± 5.0	169.0 ± 6.3	169.6 ± 6.8
Weight (kg)	53.0 ± 3.0 <sup>*?</sup>	55.4 ± 7.1 <sup>?</sup>	64.0 ± 13.7
Body Mass Index (kg/m <sup>2</sup> )	18.7 ± 1.0 <sup>*?</sup>	19.2 ± 2.13 <sup>?</sup>	22.0 ± 3.8
Training hours per week (hours)	16.8 ± 5.4 <sup>μ</sup>	9.4 ± 3.0	--
Duration of training (years)	5.0 ± 3.4	6.3 ± 4.1	--

ANOVA test and Student's t-test used to compare the means

μ - Significantly higher than university runners; \* - Significantly lower than university runners; ? - Significantly lower than the controls  
NLDR - National Level Long Distance Runners; ULDR - University Level Long Distance Runners

**Table 2:** Age, anthropometry and training data of national level and university level sprinters and controls

<b>Baseline characteristics</b>	<b>NSR (n = 20) (Mean ± SD)</b>	<b>USR (n = 21) (Mean ± SD)</b>	<b>Control (n = 41) (Mean ± SD)</b>
Age (years)	23.8 ± 3.2	22.5 ± 1.5	23.0 ± 1.4
Height (cm)	171.6 ± 6.5	173.8 ± 5.3	169.6 ± 6.8
Weight (kg)	65.1 ± 9.6	65.0 ± 13.1	64.0 ± 13.7
Body Mass Index (kg/m <sup>2</sup> )	21.8 ± 2.2	21.8 ± 4.2	22.0 ± 3.8
Training hours per week (hours)	20.9 ± 7.7 <sup>μ</sup>	8.9 ± 4.2	--
Duration of training (years)	6.9 ± 3.3	5.9 ± 3.6	--

ANOVA test and Student's t-test used to compare the means

μ - Significantly higher than university runners; NSR - National Sprint Runners; USR – University Sprint Runners

**Table 3:** Cardiopulmonary fitness parameters of national level long-distance runners, university level long distance runners and controls

<b>Parameter</b>	<b>NLDR (n = 27) Mean ± SD</b>	<b>ULDR (n = 27) Mean ± SD</b>	<b>Controls (n = 41) Mean ± SD</b>
VO <sub>2max</sub> (ml/kg/min)	58.2 ± 9.4 <sup>μ¶</sup>	50.6 ± 7.4 <sup>¶</sup>	37.4 ± 6.5
METs	16.6 ± 2.6 <sup>μ¶</sup>	14.4 ± 2.1 <sup>¶</sup>	10.9 ± 2.1
Exercise Duration (min.)	12.6 ± 2.0 <sup>μ¶</sup>	11.1 ± 1.2 <sup>¶</sup>	9.5 ± 1.1
Work load (W)	302.1 ± 79.4 <sup>μ¶</sup>	259.2 ± 39.5	223.8 ± 51.6
HR <sub>rest</sub> (beats/min)	59.5 ± 12.9 <sup>*?</sup>	68.0 ± 10.2 <sup>?</sup>	78.6 ± 21.4
HR <sub>peak</sub> (beats/min)	165.8 ± 12.1	169.7 ± 13.9	164.4 ± 19.7
SBP <sub>rest</sub> (mm Hg)	120.0 ± 8.97	120.0 ± 10.76	123.57 ± 6.98
SBP <sub>peak</sub> (mm Hg)	158.46 ± 13.48 <sup>μ¶</sup>	154.0 ± 8.94 <sup>¶</sup>	144.39 ± 8.38
DBP <sub>rest</sub> (mm Hg)	70.0 ± 6.43 <sup>?</sup>	70.0 ± 8.32 <sup>?</sup>	80.0 ± 3.10
DBP <sub>peak</sub> (mm Hg)	85.12 ± 5.06	83.0 ± 4.70	85.85 ± 4.98

ANOVA test used to compare the means

μ - Significantly higher than university runners; ¶ - Significantly higher than the controls; \* - Significantly lower than university runners; ? - Significantly lower than controls; NLDR - National Level Long Distance Runners; ULDR - University Level Long Distance Runners



**Table 4:** Cardiopulmonary fitness parameters of national level sprinters, university level sprinters and controls

Parameter	NSR (n = 20) Mean ± SD	USR (n = 21) Mean ± SD	Controls (n = 41) Mean ± SD
VO <sub>2max</sub> (ml/kg/min)	47.6 ± 8.4 <sup>¶</sup>	45.1 ± 6.4 <sup>¶</sup>	37.4 ± 6.5
METs	13.6 ± 2.4 <sup>¶</sup>	12.8 ± 1.8 <sup>¶</sup>	10.9 ± 2.1
Exercise Duration (min.)	12.8 ± 3.3 <sup>μ¶</sup>	10.9 ± 1.3 <sup>¶</sup>	9.5 ± 1.1
Work load (W)	285.6 ± 78.1 <sup>μ¶</sup>	269.2 ± 36.0 <sup>¶</sup>	223.8 ± 51.6
HR <sub>rest</sub> (beats/min)	66.0 ± 10.3 <sup>*?</sup>	75.57 ± 15.2	78.67 ± 21.4
HR <sub>peak</sub> (beats/min)	171.3 ± 12.5 <sup>¶</sup>	172.2 ± 11.6 <sup>¶</sup>	164.4 ± 19.7
SBP <sub>rest</sub> (mm Hg)	123.31 ± 4.97	120.0 ± 14.76	123.57 ± 6.98
SBP <sub>peak</sub> (mmHg)	157.50 ± 14.52 <sup>μ¶</sup>	151.0 ± 12.93 <sup>¶</sup>	144.39 ± 8.38
DBP <sub>rest</sub> (mmHg)	70.40 ± 2.00 <sup>?</sup>	70.0 ± 6.97 <sup>?</sup>	80.0 ± 3.10
DBP <sub>peak</sub> (mmHg)	85.60 ± 5.06 <sup>μ</sup>	81.5 ± 3.66 <sup>?</sup>	85.85 ± 4.98

ANOVA test used to compare the means

μ - Significantly higher than university runners; ¶ - Significantly higher than the controls; \* - Significantly lower than university runners; ? - significantly lower than controls; NSR - National Sprint Runners; USR - University Sprint Runners

### Cardiopulmonary fitness parameters

The mean VO<sub>2max</sub>, METs (functional capacity), exercise duration on cycle ergometer and work load of NLDR were significantly higher when compared with ULDR and control subjects ( $p < 0.05$ ). ULDR had significantly higher VO<sub>2max</sub>, METs and duration of exercise in comparison to controls ( $p < 0.05$ ). HR<sub>rest</sub> was significantly lower amongst NLDR and ULDR than controls. HR<sub>peak</sub> was not significantly different between runners and controls ( $p > 0.05$ ). SBP<sub>peak</sub> of NLDR and ULDR were significantly higher than that of the controls ( $p < 0.05$ ). NLDR and ULDR had significantly lower DBP<sub>rest</sub> compared to controls ( $p < 0.05$ ).

The NSR had significantly higher exercise duration on cycle ergometer, work load than USR and controls ( $p < 0.05$ ). However, the VO<sub>2max</sub> level and METs of NLDR had no significant difference when compared with USR. HR<sub>rest</sub> and HR<sub>peak</sub> of NSR and USR were significantly lower than the

controls ( $p < 0.05$ ). The mean SBP<sub>peak</sub> of NSR and USR were significantly higher than the controls ( $p < 0.05$ ). The mean DBP<sub>rest</sub> of NSR and USR were significantly lower than the controls ( $p < 0.05$ ). The mean DBP<sub>peak</sub> of NSR and controls were significantly higher than the USR ( $p < 0.05$ ).

### Discussion

The purpose of this study was to determine the current status of CPET parameters of NLDR and NSR in comparison with ULDR, USR and controls. To the best of the authors' knowledge this is the first study conducted in Sri Lanka to assess the CPET parameters of national and university level runners using real time gas analysis.

In the present study, the age and the height were found to be similar between NLDR, NSR, ULDR, USR and control subjects. NLDR were found to

have the lowest body weight and BMI amongst national level runners, university level runners and controls. This may be due to the engagement of NLDR in regular endurance training than the other runners. The distribution of age, height, weight and BMI of Sri Lankan NLDR and NSR were found to be similar to available data of international long distance runners in the region (12).

In the present study,  $VO_{2max}$  of NLDR was lower than the international long distance runners in the region (12). Deficiencies of the endurance training programs including unavailability of high-altitude training may be a reason for the lower  $VO_{2max}$  level of NLDR. However, the mean  $VO_{2max}$  of NLDR was significantly higher when compared to the  $VO_{2max}$  of ULDR and the control subjects.

In the present study, NLDR had lower peak work load at the point of exhaustion during the CPET assessment compared to previously reported data of Asian runners (13). However, the peak work load of NLDR was significantly increased compared to the university counterparts.

In the present study, as expected, higher  $VO_{2max}$  level was observed in NSR and USR when compared to controls. The reason for the higher levels of  $VO_{2max}$  amongst NSR and USR than controls may be the lower cardiopulmonary fitness levels of physically less active controls.

Sri Lankan NSR had achieved the  $VO_{2max}$  on par with the data of international sprinters in the region reported in the literature (12, 14). However, the USR and NSR also had similar level of  $VO_{2max}$ .

The NLDR and NSR had significantly higher exercise duration on cycle ergometer, exercise capacity and peak work load along with the higher  $VO_{2max}$  when compared to ULDR and USR. When an athlete is engaged in regular training on selected groups of muscles, such as leg muscles for a longer duration of time it will cause an increase of  $VO_{2max}$  level and psychological tolerance to fatigue (15). Even though the national runners and the university runners were engaged in technical sports training for a similar duration; NLDR and NSR were engaged in significantly higher training hours per week than the university counterparts. The higher tolerance to fatigue achieved through longer training may be the reason for the significantly higher exercise

duration on cycle ergometer, exercise capacity and peak work load of national runners than the University runners. However, the peak work load of NSR is far below than the peak work load of elite Asian sprinters (16). As explained in literature, there is a strong positive correlation of peak power output and running speed of elite sprinters (17). As depicted by the present study, lower peak work load may be a reason for poor performance of NSR and USR.

NLDR had the lowest  $HR_{rest}$  whereas the NSR and had the highest  $HR_{peak}$  amongst the national runners, University runners and the controls. Earlier studies have reported that professional endurance runners had significantly lower resting blood pressure ( $SBP_{rest}$  and  $DBP_{rest}$ ) than other people (10). In the present study, an isolated reduction of  $DBP_{rest}$  was observed amongst national and university runners which is in accordance with the available data of Asian elite long distance runners (18). However, no difference was observed of mean  $SBP_{rest}$  amongst the national and university runners when compared to the controls. Significantly higher mean  $SBP_{peak}$  was observed amongst national runners when compared with the university counterparts and the control subjects. This may be due to the higher exercise level and the higher tolerance of fatigue amongst national runners gained through comparatively longer duration of training.

The results of the present study indicate that sub optimal remodelling of the cardiovascular system had been attained by NLDR and NSR irrespective of the rigorous training when compared to university counterparts. However, as depicted by lower  $HR_{rest}$  and  $DBP_{rest}$  of NLDR, the parasympathetic effect of training was pronounced amongst long distance runners when compared to sprinters and controls.

## Conclusions

The present study concludes that lower levels of cardiopulmonary fitness parameters such as  $VO_{2max}$  and peak power output of Sri Lankan national long distance runners may be detrimental to optimal performance at international arena. Although Sri Lankan sprinters achieved similar  $VO_{2max}$  as reported amongst international sprinters, lower peak power output is a major limiting factor

of performance. Suboptimal remodelling of the cardiovascular system is the main reason for the lower level of cardiopulmonary fitness of Sri Lankan long distance runners and sprinters. Training protocols are known to contribute to cardiovascular remodelling. Thus, training protocols need to be modified in accordance with the base line CPET parameters to attain optimal cardiovascular remodelling, and thus enhance performance.

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# Health and social problems following illicit drug use among males experiencing incarceration in prison; a cross sectional study on single centre experience

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## ABSTRACT

**Introduction:** Illicit drug use is a growing public health problem which affects health and social wellbeing of drug users. A significant proportion of prison admissions is illicit drug-related in many countries including Sri Lanka. This study was conducted to describe the possible health and social problems linked with illicit drug use among males experiencing incarceration in prison, Galle.

**Methods:** A cross-sectional study was conducted among 254 males experiencing incarceration with history of illicit drug use in prison, Galle. An interviewer assisted, self-administered questionnaire was used to assess the presence of known health and social problems linked with illicit drug use which were identified through literature. Associated factors for presence of health and social problems following illicit drug use were assessed using Chi square test at 0.05 significance level.

**Results:** Drug-related prison admissions were reported among 79.1% of individuals and 57.1% of individuals were prison readmissions. Poly drug use (36.2%) and drug dependence (56.7%) was reported in significant proportion of males experiencing incarceration. Drug Abuse Screening test (DAST) 20 revealed that 35.4% of individuals had higher level of problematic drug use. Health and social problems following illicit drug use were common among individuals experiencing incarceration and their presence was associated with poly drug use, drug dependence and problematic drug use ( $p < 0.05$  for all).

**Conclusion:** Past illicit drug use and related health and social problems were common among inmates in prison, Galle, creating a considerable burden for the prison system of the country.

**Key words:** *Health problems, illicit drug use, males experiencing incarceration, social problems.*

## Introduction

Illicit drugs are defined as psychoactive substances whose production, sale or long term use on regular basis for a non-medical purpose is prohibited with the prevailing legal system of a given country (1). Heroin, cannabis, cocaine, crystal meth, hallucinogens and psychotropic drugs etc. are illicit

drugs that are commonly found in Sri Lanka. Addiction or usage of these illicit drugs has become a significant problem in the country (2). It harms not only the people who take drugs, but also the people around them including children, families and the society (3).

Illicit drug use can affect people at any age, from any background, rich or poor. It leads to many health and social problems. According to the World Drug Report, illicit drug use causes a variety of health and social consequences accounting for an increased global burden. A person who uses illicit drugs can come from all walks of life and many suffer from medical, psychological, occupational, financial, legal, family and social relationship problems. Conflicts due to neglecting responsibilities, negligence within family, problems with sexual relationships and engaging in illegal activities to purchase drugs were identified as issues with immediate family and social impact linked with illicit drug use. All of these problems render their addictive behaviour much more difficult to treat. Additionally, addiction increases the addict's risk to a wide variety of other illnesses affecting many systems of the body. These may come about due to the toxic effects of the drugs or as a result of the poor living and health habits that is normally associated with the lifestyle and behaviour of the addict. Furthermore, it causes significant burden for the economy of the country, mainly for health services and rehabilitation programmes (2, 4).

Prison population is considered as one of the most vulnerable groups among vulnerable populations to get addicted to illicit drugs (5). Although they deserve to be the focus of some health and social interventions according to existing evidence; generally less attention is given to this group across the globe (6). The situation is similar in Sri Lanka. Illicit drug use is a common problem among prison population (7-9) and drug related offences account for much of the prison admission (8, 9), making it a significant health and social concern. Yet, scant attention has been given to explore this problem in the local context. This paucity of data has further impeded the development and implementation of preventive and health promotion activities targeting illicit drug users including individuals experiencing incarceration. This study attempted to identify possible health and social problems linked with illicit drug use among males experiencing incarceration who had history of illicit drug use in prison Galle. The identification of these problems will help relevant authorities to take necessary actions for solving and preventing them, which would be beneficial for individuals experiencing incarceration

themselves and other affected groups such as their families and immediate society.

## Methods

A cross sectional study was conducted among a sample of 254 males experiencing incarceration and had history of illicit drug use in prison, Galle from February 2018 to January 2019. Random sample of 449 males experiencing incarceration was selected in initial stage of the study and they were screened using Drug Abuse Screening Test 20 (DAST 20) to identify individuals with history of illicit drug behaviour. Accordingly, among 449, 254 individuals were identified with history of illicit drug behaviour. According to prison statistics, majority of the prison admissions were male (>94%) in prison Galle (9) and therefore only the male prison population was included for the study. The study sample included adult male prisoners who were convicted, remanded or who had appealed against the conviction, having history of illicit drug use and only those admitted within one year prior to data collection. After confirming eligibility, each study subject was approached through prison medical centre. The support of the prison medical officer was obtained for subject recruitment. Permission was obtained from the Commissioner General of Prison, Department of Prison, Ministry of Justice and Prison Reforms, Sri Lanka to recruit the subjects. Ethical approval for the study was obtained from the Ethical Review Committee of the Postgraduate Institute of Medicine, University of Colombo, Sri Lanka.

A pretested, interviewer-assisted, self-administered questionnaire with closed ended questions was used to assess health and social problems following illicit drug use in order to ensure a high response rate and accuracy of data divulged after obtaining informed written consent from the participants. ICD 10 symptom checklist for substance use disorder was used to identify those having drug dependence. DAST 20 was used to assess the problematic level of drug use. Possible health and social problems following illicit drug use that were identified through literature search were included in the questionnaire. This was assessed according to the individual perception. However, diagnosis of disease conditions which were obtained from

study participants was confirmed using medical records available at prison medical centre whenever possible as no other method was available to ensure health problems following illicit drug use.

All data were collected by the principal investigator and privacy and confidentiality were strictly maintained. Data were coded and entered into an *Epi Info*<sup>TM</sup> data sheet and transferred to a data base created using the Statistical Package for Social Sciences (SPSS) software (version 20). After cleaning the data set, frequency tables and other descriptive methods were applied to observe the behavior of different variables. DAST score was compared with the American Society of Addiction Medicine (ASAM) Placement Criteria to assess problematic level of illicit drug use; drug users with DAST scores compatible with level III and IV of ASAM criteria were considered as having high problematic level and drug users with DAST scores corresponding to level I and II were considered as having low problematic level. Associated factors for presence of health and social problems linked with illicit drug use were assessed with drug dependence status, problematic level of drug use, poly-drug use and prison readmission status using Chi square test. Level of significance was considered as 0.05.

## Results

### *Sample Characteristics*

Nearly all the individuals (97.6%) were resident in Galle district. Majority of individuals were Sinhalese (97.6%), Buddhist (96.9%) and less than 36 years old (71.1%) with mean (SD) of 30.6 (7.6) years. Nearly three-fourth of sample had lower (less than GCE O/L) education level (75.6%), were unskilled manual workers (59.1%) and had satisfactory (more than 25,000 rupees) monthly income (71.3%). Drug related prison admissions were reported among 79.1% of individuals and 57.1% of individuals were prison readmissions. Poly drug use (36.2%) and drug dependence (56.7%) was reported in significant proportions of males experiencing incarceration. DAST 20 revealed that 35.4% of individuals had higher level of problematic drug use while 64.6% had lower level according to the American Society of Addiction Medicine (ASAM) criteria.

### *Health problems linked with illicit drug use before imprisonment*

Accident and injuries (23.2%) and dental caries (16.9%) were reported as common health problems following drug use among males experiencing incarceration in prison, Galle before imprisonment (Table 1). At least one health problem due to past illicit drug use was reported among 43.7% (n = 111) of individuals. There were 41.7% with risky sexual behaviours among past illicit drug users, including 9.1% with homosexual behavior. Further 13.7% reported IV drug use.

Presence of at least one health or related problem due to illicit drug use was taken as presence of health problems due to past illicit drug use. Presence of health problems due to past illicit drug use was significantly associated with poly drug use, drug dependence and problematic drug use (Table 2). Individuals experiencing incarceration who had history of poly drug use ( $p < 0.001$ ), drug dependence ( $p < 0.001$ ) and having higher level of problematic drug use ( $p < 0.001$ ) were more likely to have health problems following illicit drug use.

### *Social problems linked with illicit drug use before imprisonment*

Legal problems (72.8%), financial problems (51.6%) and employment problems (26.0%) were identified as common social problems among individuals experiencing incarceration in prison, Galle following illicit drug use before imprisonment (Table 3). At least one social problem following past illicit drug use was reported among 83.0% (n = 211) of individuals experiencing incarceration.

Statistically significant associations for presence of social problems following illicit drug use were identified with poly drug use, drug dependence and problematic drug use (Table 4). Individuals experiencing incarceration, who had history of poly drug use ( $p < 0.001$ ), drug dependence ( $p < 0.001$ ) and high level of problematic drug use ( $p = 0.001$ ) were more likely to have social problems following illicit drug use. Individuals experiencing incarceration who had previous prison admissions were not associated with presence of health or social problems.

**Table 1:** Health-related problems linked with illicit drug use among males experiencing incarceration in prison, Galle (n = 254)

Health-related problems	Number (%) *
Accidents / Injuries	59 (23.2)
Dental carries	43 (16.9)
Skin diseases	23 (9.1)
Respiratory diseases (Asthma / COPD)	21 (8.3)
Suicidal attempts	13 (5.1)
Cardiovascular diseases	11 (4.3)
Significant weight loss	10 (3.9)
Sexual dysfunction	6 (2.4)
Psychiatric disorders	4 (1.6)
Blood borne viral infections	3 (1.2)
Tuberculosis	1 (0.4)
Sexually transmitted diseases	1 (0.4)

\* Percentages do not add up to 100% due to multiple responses

**Table 2:** Factors associated with presence of health problems following illicit drug use among males experiencing incarceration in prison, Galle (n = 254)

Characteristics	Presence of health problems			p value
	Yes (n = 111) Number (%)	No (n = 143) Number (%)	Total Number (%)	
<b>Poly drug use</b>				
Yes	58 (63.0)	34 (37.0)	92 (100)	<0.001 *
No	53 (32.7)	109 (67.3)	162 (100)	
<b>Drug dependence</b>				
Yes	83 (57.6)	61 (42.4)	144 (100)	<0.001 *
No	28 (25.4)	82 (74.6)	110 (100)	
<b>Problematic level of drug use</b>				
Low	53 (32.3)	111 (67.7)	164 (100)	<0.001 *
High	58 (64.4)	32 (35.6)	90 (100)	
<b>Readmissions to prison</b>				
Yes	69 (47.6)	76 (52.4)	145 (100)	0.150
No	42 (38.5)	67 (61.5)	109 (100)	

\* p value is significant at 0.001

**Table 3:** Social problems linked with illicit drug use among males experiencing incarceration in prison, Galle (n = 254)

Social Problem	Number (%)*
Legal problems	185 (72.8)
Financial problems	131 (51.6)
Employment problems	66 (26.0)
Disputes in community	60 (23.6)
Disrupted family relationships	54 (21.3)
Conflicts with neighbours	37 (14.6)
Domestic violence	11 (4.3)
Negligence by the family	4 (1.6)

\* Percentages do not add up to 100% due to multiple responses

**Table 4:** Factors associated with presence of social problems following illicit drug use among males experiencing incarceration in prison, Galle (n = 254)

Characteristics	Presence of social problems			p value
	Yes (n = 211) Number (%)	No (n = 43) Number (%)	Total Number (%)	
<b>Poly drug use</b>				
Yes	89 (96.7)	3 (3.3)	92 (100)	<0.001 *
No	122 (75.3)	40 (24.7)	162 (100)	
<b>Drug dependence</b>				
Yes	134 (93.1)	10 (6.9)	144 (100)	<0.001 *
No	77 (70.0)	33 (30.0)	110 (100)	
<b>Problematic level of drug use</b>				
Low	127 (77.4)	37 (22.6)	164 (100)	0.001 **
High	84 (93.3)	6 (6.7)	90 (100)	
<b>Readmission to prison</b>				
Yes	124 (85.5)	21 (14.5)	145 (100)	0.230
No	87 (79.8)	22 (20.2)	109 (100)	

\* p value is significant at 0.001 ; \*\* p value is significant at 0.05



## Discussion

In this study, outcomes of past illicit drug use were assessed under health and social problems known to be related to their use. This study identified accidents and injuries, dental caries, respiratory diseases and skin diseases as common health problems which are comparable with those in the literature. However, health problems were not assessed in depth in a descriptive manner and the participants were only asked to select the problems experienced by them from a given problem list that had been prepared according to evidence available in the literature. Although 'other' option was included to record anything other than those in the list, response rate was negligible for that option. Therefore, it could be anticipated that information bias can affect this part of the results. However, a comprehensive list of health problems identified through several sources was included in the questionnaire to minimise this possibility. Although study subjects were recruited through the prison medical centre, there was a difficulty in accessing prison medical records which are maintained by prison medical officers at prison for verification of reported problems due to ethical issues. Therefore, only the past medical records (e.g. clinic books and diagnosis cards of prison inmates) were used to retrieve data.

In the literature, many studies have found that accident and injuries following illicit drug use are very common in many countries (10-12) comparable to our study finding. This is mainly occurred due to impulsive behaviour following its illicit drug use. It has been reported that many illicit drugs cause dental carries due to chemicals in them (13). It was not uncommon in this study too and dental caries were reported by 16.9% of illicit drug users. Similar to our findings, respiratory diseases are not uncommon among drug users. Tuberculosis, bronchial asthma, chronic obstructive pulmonary diseases were identified as common respiratory problems comparable to our study findings in the literature (14, 15). Skin diseases were prevalent among the inmates of our study. An association has been observed between skin diseases and illicit drug use; dermatitis, skin and soft tissue infections were identified as common dermatological conditions and many of them are due to poor hygiene of drug users and the practice of injecting drugs (16).

Other adverse health consequences were reported in low prevalence in our study were not in concordance with the literature. According to a study done by Dissabandara *et al.* (2009), 11.2% reported a history of sexually transmitted diseases (STD). In contrast, it was 0.4% in this study sample. Blood borne viral infections were reported by 1.2%. However, there were 41.7% with risky sexual behaviours among past illicit drug users and 13.7% reported IV drug use. Although STD and blood borne viral infections were reported in lower percentages, considering the high prevalence of risk behaviours it will be worthwhile to screen prison inmates for STD. Psychiatric disorders were reported among 29% of prison inmates in a study conducted in Australia (17). In comparison, a very low percentage (1.6%) was observed in the present study. This low prevalence of health problems in the present study could be due to under-reporting of health problems resulting from the inadequate appraisal in the study. Combining self-reported information with a thorough clinical examination and analysis of past medical records would have been useful in minimising this error.

When considering, adverse social consequences linked with illicit drug use, legal problems, financial problems, employment problems, disputes in community, disrupted family relationships and disruption of academic activities were identified as common social problems. According to available evidence in Sri Lanka, disruption of family relationships, employment problems, legal problems, negligence within family and disruption of sexual relationships are common social problems among drug users (18). Interestingly, domestic violence was not reported in their study. However, apart from above mentioned social problems, domestic violence was reported among 4.3% of drug users in our study.

Domestic violence was reported in a similar study conducted in the Netherlands in relation to cannabis and cocaine use (19). Moreover, financial problems, legal problems and disruption of family relationships were similarly reported in another study done in India (20). Most of the drug users try to keep their problems due to illicit drug use under cover due to fear of discrimination. This further affects their problematic level of drug use (21). These findings were comparable with the literature (20-22).

Prison inmates, who had a history of poly drug use, addicted to illicit drugs and had a higher level of problematic drug use were more likely to have health or social problems linked with illicit drug use. Drug users who used multiple drugs, addicted to drugs and had higher problematic level drug use are usually more vulnerable to adverse consequences following drug use as all of these factors lead them to more exposure to illicit drugs. Therefore, unsurprisingly they were more likely to have health or social problems linked with illicit drug use.

In this study, new problems related to behaviour of illicit drug use could not be identified except those already identified through literature. There is a lack of data on health problems and social problems related to illicit drug use even in global and regional literature. This emphasises the need for more research studies for further evaluation of health and social problems related to illicit drug use.

### Limitations

There were a few limitations in this study. Several precautions had to be taken during the designing stage as the study included a vulnerable population. It was ensured that the responses provided by the participants will allow them to be identified neither within their own local community nor the larger national or academic community to which the findings of the study will be presented to. Hence, prison officials' help was not obtained for study subject recruitment. Every study subject was approached through the prison medical centre and the support from prison medical officer was obtained for subject recruitment. A self-administered format was used to optimise the response rate as the questionnaire addressed sensitive issues. Further, legal status of prisoners (convicted, remanded or appealed against the conviction) was not questioned to avoid misinterpretation by the participants that it would affect any services or decisions they received or would receive in future and any adverse consequences of them. As outcomes of past illicit drug use were assessed under health and social problems known to be related following drug use, it limited the comprehensiveness of assessment. Study had to rely on individual perception of possible health and social problems following

drug use. As the research addressed sensitive issues, some questions were omitted to avoid ethical issues, thereby. Furthermore, the study population was limited to the prison, Galle limiting the generalisability of findings as described elsewhere in this paper. In addition, the cross-sectional nature of the study may have masked the temporal relationship between past illicit drug use and associated problems. The possibility of recall bias and bias due to 'socially desirable responses' cannot be overlooked, although every step was taken to minimize it. However, study subjects were recruited using pre-determined inclusion and exclusion criteria to avoid possible biases. Prison inmates who were imprisoned more than one year to minimise recall bias and those who were mentally unsound were excluded from the study to minimize information bias. Study subjects were supported by principal investigator during the process with any clarifications if required to minimize information bias.

In summary, it was identified that health problems and social problems due to past illicit drug use among prison inmates were common and they were associated with poly drug use, drug dependence and problematic drug use. As there is a lack of data in relation to health and social problems linked with past illicit drug use among prison inmates in Sri Lanka, result of this study will be helpful for policy makers and practitioners to develop preventive strategies for prison inmates with a history of illicit drug use. Identification of prison inmates who had a past illicit drug use will be required at the time of prison admission, which will be required to refer them to proper rehabilitation care. These measures will be beneficial to reduce burden on prison system of the country due to illicit drug use. Hence findings of this study can be used in national development of the country.

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Manuscript does not contain any individual data in any form (including any individual details, images or videos). Therefore, consent for publication was not considered.


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# Identifying thyroid follicular proliferations that need lobectomy; value of the Bethesda category 4

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## ABSTRACT

**Introduction:** Thyroid follicular proliferations (TFPs) identified on fine needle aspiration cytology can be either follicular lesions of undetermined significance; Bethesda category 3 or follicular neoplasms and lesions suspicious for a follicular neoplasm; Bethesda category 4. The purpose of categorizing to Bethesda category 4 is to identify a thyroid nodule that might be a follicular carcinoma and triage it for thyroid lobectomy. This study was designed to determine the predictive value of categorizing TFPs to Bethesda category 4 in deciding on lobectomy for cytologically identified TFPs.

**Methods:** This retrospective study included all patients with TFPs identified on cytology, and had a subsequent histological diagnosis, at our unit, over a period of two years. TFPs were categorized into either Bethesda category 3 or 4 on cytology, according to the Bethesda system. Sensitivity, specificity and positive (PPV) and negative predictive values (NPV) for Bethesda category 4 in identifying neoplastic TFPs and implied risk of malignancy for Bethesda category 3 and 4 were calculated taking histopathology as the gold standard. A total of 52 TFPs (Bethesda category 3; n = 39, Bethesda category 4; n = 13) were included. Subsequent histology has confirmed 18 neoplastic and 34 non-neoplastic TFPs. Sensitivity and specificity of Bethesda category 4 in identifying neoplastic TFPs were 66.66% and 97.05% respectively. PPV and NPV of Bethesda category 4 were 92.3% and 84.6% respectively. Implied risk of malignancy for Bethesda category 3 and 4 were 5.12% and 15.38% respectively.

**Conclusions:** Bethesda category 4 predicts the TFPs that need thyroid lobectomy to triage for follicular carcinoma. The Bethesda category 3 and 4 carry an implied risk of malignancy comparable to the expected values given in Bethesda system.

**Key Words:** *Bethesda system, cytology, follicular proliferations, neoplastic and non-neoplastic lesions, thyroid.*

## Introduction

Thyroid nodules are frequently encountered neck lumps in surgical pathology practice, which can either be neoplastic or non-neoplastic. A neoplastic thyroid enlargement could be either benign or malignant. The common benign non-neoplastic conditions of the thyroid gland, sometimes presenting as nodules are, dominant nodule of

multinodular goitre, thyroiditis, colloid cysts, hyperplastic nodules and Grave's disease. Neoplastic lesions can be benign adenomas and differentiated or undifferentiated carcinomas (1). Patients with these nodules usually present with clinically significant palpable nodules or they can be incidental findings in radiological examination.

Fine Needle Aspiration Cytology (FNAC) plays a pivotal role in the diagnosis of these thyroid lesions, and it has been identified as the method of choice among other modes of investigations (2). FNAC is accepted as an accurate, relatively inexpensive and rapid to diagnose thyroid lesions preoperatively. Its overall sensitivity and specificity are reported to be 95% and 98% respectively (3).

By using adequately sampled, well prepared smears, diffuse changes such as thyroiditis, colloid goitres as well as malignant lesions like papillary carcinoma, medullary thyroid carcinoma, anaplastic carcinoma and thyroid lymphoma can often be diagnosed. However, the pathologist has to be accurate in the preoperative cytological diagnosis of follicular lesions as the surgical management is different for the non-neoplastic and neoplastic proliferations. Final confirmation of the diagnosis of follicular carcinoma and adenoma are solely dependent on histological identification of capsular or vascular invasion following surgery (4). In addition, the presence of several differential diagnoses for the follicular cytoarchitectural pattern results in problems in interpreting follicular pattern in cytology. The various types of follicular lesions encountered in thyroid cytology have variable risk of malignancy. These include; hyperplastic nodules, follicular or Hürthle cell adenomas, follicular variant papillary thyroid carcinoma and the recently described indolent lesion; Non-Invasive Follicular Tumour with Papillary-like nuclear features (NIFTP) (4).

Although, it seems that accurate preoperative cytological diagnosis of a follicular lesion is a debatable issue, the cytoarchitectural details seen in a smear can be used as a screening test for follicular lesions of the thyroid. In this regard, the necessity for a standardized reporting system was felt extremely important, and the THY system has been used for this purpose up to 2017 in Sri Lanka.

According to the THY system, when the fine needle aspiration cytology of thyroid shows follicular pattern, it was diagnosed as Thy3 category i.e. follicular proliferation. Most of the pathologists in our setting used to favour the pattern of proliferation towards either a non-neoplastic process or a follicular neoplasm. However, there were no accepted uniform criteria to differentiate a follicular

neoplasm from non- neoplastic lesion in the THY 3 category (5). This was agreed to be a major deficiency in the THY system as further management of these two types of follicular lesions are completely different. To address this deficiency, The Bethesda System in reporting thyroid cytopathology was introduced and it was adopted in reporting thyroid fine needle aspirations in our country too (6).

The Bethesda system identifies six diagnostic categories (6). The category 1 includes non-diagnostic and unsatisfactory aspirates for reporting or cyst fluid only. The category 2 includes all benign thyroid lesions like colloid nodules, autoimmune thyroiditis, lymphocytic thyroiditis and granulomatous thyroiditis. Bethesda category 3 indicates atypia of undetermined significance or follicular lesion of undetermined significance. Bethesda category 4 includes all follicular neoplasms or suspicious for follicular neoplasm. Lesions which are suspicious for malignancy are included in the Bethesda category 5. All thyroid lesions with unequivocal cytological evidence of malignancy like papillary carcinoma, medullary carcinoma, anaplastic carcinoma, squamous cell carcinoma, metastatic carcinomas and lymphomas are included in the category 6.

In the Bethesda system, the category 3 and 4 are the newly introduced categories for thyroid cytology reporting in order to meet the aforementioned deficiency in the THY system (6). The Bethesda category 3 which denotes atypia of undetermined significance or the follicular lesion of undetermined significance recommends two management options, that is to follow up or to repeat FNAC. The category 4 which include follicular neoplasms or lesions suspicious of follicular neoplasm recommends lobectomy as the management (7). Moreover, there are standard criteria stated in the Bethesda system to categorize a follicular cytological pattern to either Bethesda category 3 or 4 (8).

Thus, adopting the Bethesda System in reporting thyroid cytopathology is expected to be helpful in better management of patients by improving preoperative identification of neoplastic follicular lesions which need lobectomy to identify possible follicular carcinoma (9).

Therefore, this study was designed to determine the validity of the Bethesda system in cytological differentiation of follicular neoplasms from non-neoplastic follicular lesions and to assess the risk of malignancy by each of the two categories; Bethesda 3 and 4.

## Methods

This retrospective study was carried out in the Department of Pathology, Faculty of Medicine, University of Ruhuna, Galle. This study included patients who were diagnosed to have follicular proliferations on cytology, either belonging to Thy3 category or Bethesda 3/4 categories at the Department of Pathology, Teaching Hospital Karapitiya and the Department of Pathology, Faculty of Medicine, University of Ruhuna. All patients subsequently underwent surgical management and received a histopathology report. Patients who were diagnosed from January 2017 to December 2018 were recruited for the study.

Patients who did not undergo surgical management for the cytologically detected follicular thyroid lesions and have not been issued with a histopathology report were excluded. Cases of Bethesda Category 3 (with no Thy 3 categorization) which were categorized into Bethesda 3 based on the presence of atypia without follicular proliferations were also excluded.

Smears from all cases of follicular proliferations were reassessed. The smears with faded staining were re-stained for reassessment. The reassessment was done by the first and the second authors independently and categorized them into either Bethesda category 3 or 4 according to the standard criteria for the Bethesda categorization (8). (Figures 1 - 4).

Any discrepancy between the two assessors were sorted by examining under a multi-head microscope arriving at a consensus on the Bethesda category. Both assessors were blinded to the original cytological and the histological diagnosis. Finally, the comparison between reclassified cytological cases and their relevant histological diagnosis (the gold standard) was done. On comparison, histology of the relevant lesion which was subjected to FNAC, was considered for the analysis and pathology of the rest of the specimen was assessed

as background pathology only.

By correlating with histopathology, sensitivity, specificity and positive (PPV) and negative predictive values (NPV) for Bethesda Category 4, in identifying neoplastic TFPs and implied risk of malignancy for Bethesda Category 3 and Bethesda Category 4 were calculated.

Ethical approval for the study has been obtained from Ethical Review Committee, Faculty of Medicine, University of Ruhuna.

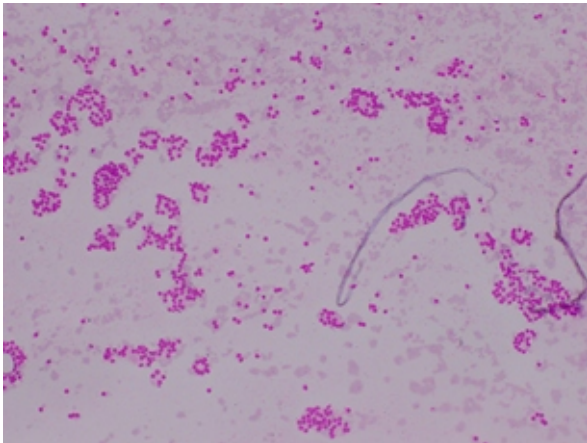
## Results

Seventy patients with cytologically diagnosed follicular proliferations in the thyroid gland were identified in these two centers during the period of two years. Histopathology reports were available only in 48 patients. As there were 4 patients within the total 48 patients with bilateral thyroid nodules and they had received separate cytology reports for those nodules as follicular proliferations at different times, every single clinical nodule was counted separately. Finally, a total of 52 cases of follicular proliferation in the thyroid gland were included. Among them, 39 cases (75%) were diagnosed as Bethesda category 3 and the other 13 cases (25%) were diagnosed as Bethesda category 4.

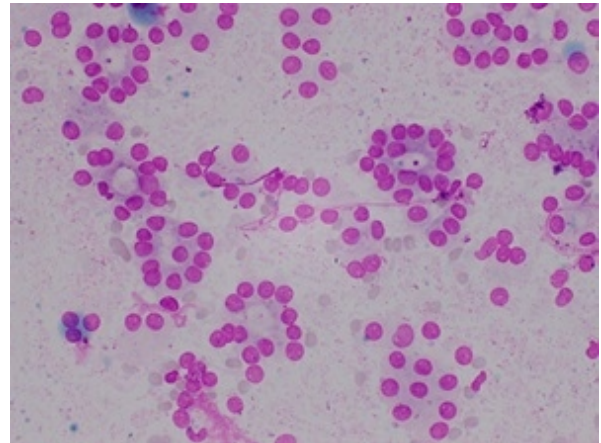
Subsequent histology has confirmed 18 neoplastic and 34 non-neoplastic thyroid follicular proliferations (Table 1). Comparison of the Bethesda category and the corresponding histological pattern of the follicular lesion is shown (Table 2).

These results were analysed to assess the validity of the Bethesda system in cytological differentiation of neoplastic and non-neoplastic follicular lesions. In order to assess the validity; sensitivity, specificity, positive predictive value and the negative predictive value of Bethesda 4 category in identifying neoplastic follicular lesions were calculated (Table 3).

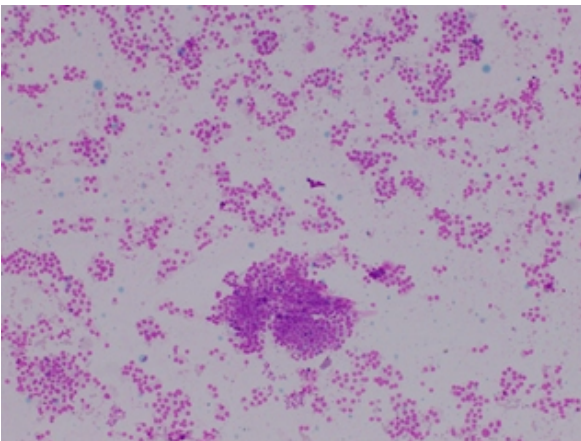
Sensitivity of Bethesda category 4 was 66.66% and the specificity was 97.05%. Positive predictive value was 92.3% and negative predictive value was 84.6%. Implied risk of malignancy for Bethesda category 3 and Bethesda category 4 were 5.12% ( $2/39 \times 100$ ) and 15.38% ( $2/13 \times 100$ ) respectively.



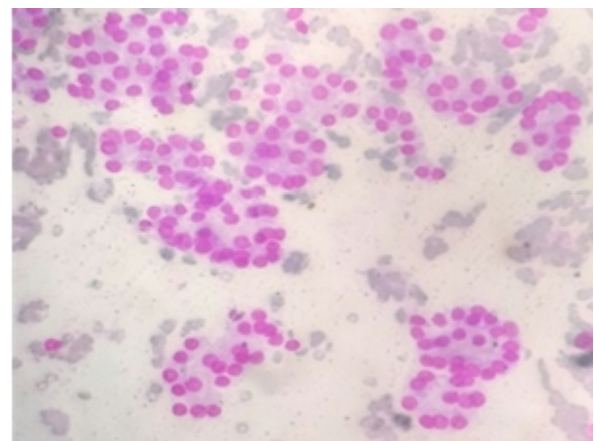
**Figure 1:** Follicular proliferation in cytology - Bethesda category 3 (Leishman stain, x 40)



**Figure 2:** Follicular proliferation in cytology - Bethesda category 3 (Leishman stain, x 400)



**Figure 3:** Follicular proliferation in cytology - Bethesda category 4 (Leishman stain, x 40)



**Figure 4:** Follicular proliferation in cytology - Bethesda category 4 (Leishman stain, x 400)

**Table 1:** Comparison of the Bethesda category and corresponding histology (non-neoplastic and neoplastic status of the follicular lesion on histology)

Histopathology	Bethesda Category		Total
	Bethesda 3	Bethesda 4	
Neoplastic	6 15.4%	12 92.3%	18 34.6%
Non-neoplastic	33 84.6%	1 7.7%	34 65.4%
Total	39	13	52

**Table 2:** Comparison of Bethesda category and corresponding histological diagnosis of follicular lesions

Histopathology	Bethesda Category		Total
	Bethesda 3	Bethesda 4	
Hyperplastic nodule	18 46.2%	1 7.7%	19 26.9%
Autoimmune thyroiditis	15 38.5%	0 0.0%	15 28.8%
Adenoma	4 10.3%	10 76.9%	14 26.4%
Carcinoma (follicular carcinoma, Hürthle cell carcinoma, Follicular variant papillary carcinoma)	2 5.1%	2 15.4%	4 7.7%

**Table 3:** Assessment of the validity of Bethesda Category 4 in identifying neoplastic follicular lesions

Cytology	Gold standard – Histology		
	Positive for Neoplasm	Negative for Neoplasm	Total
Bethesda Category 4 Positive	True positives 12	False positives 1	13
Bethesda category 4 Negative	False negatives 6	True negatives 33	39
Total	18	34	52

## Discussion

This study was carried out to investigate the value of Bethesda system on reporting thyroid cytology in deciding on the surgical intervention for cytologically identified follicular proliferations in thyroid gland in a tertiary care hospital. The current study sample of 52 follicular proliferations had 75% cases of Bethesda category 3 and 25% of Bethesda category 4. This finding was comparable with the findings of other studies, where cohort incidence rate of Bethesda 3 category was 4 times higher than Bethesda category 4 (8% and 2% respectively) (10).

The calculated sensitivity and specificity of Bethesda category 4 were, 66.66% and 97.05%, respectively. Further, Bethesda category 4 criteria has 97.05% specificity in excluding non-neoplastic follicular proliferations on cytology. Similarly, the positive and negative predictive value in identifying neoplastic follicular lesion by Bethesda

category 4 were 92.3% and 84.6% respectively. This also explains that Bethesda category 4 criteria can specifically identify neoplastic follicular lesions in cytology, and there is 92% predictability of a lesion becoming neoplastic when a smear is assigned to Bethesda category 4.

In the same way, by looking at the cytology smear of a follicular lesion, a pathologist can predict with 92% probability that the lesion cannot be a neoplastic follicular lesion. That is, when a smear was categorized into Bethesda category 3, only 8 out of 100 cases need surgical intervention and remainder needs only the follow-up. This prevents unnecessary surgical intervention in patients with non-neoplastic thyroid follicular lesions.

The implied risk of malignancy for Bethesda category 3 was 5.12% and that for Bethesda category



4 was 15.38%. These figures are comparable to the study done by Mosca *et al.*, and the Bethesda guidelines (6, 11).

Similarly, several studies have concluded that the implied risk of malignancy for Bethesda category 4 to be between 15 to 30% (12, 13). Although, our value complies with those results, it occupies the lower limit of the reported range. This might be due to the small size of the sample assessed in our study. However, these results clearly explain that the lesions of thyroid having cytologically detected follicular proliferation, categorized into Bethesda category 3 has very low risk of malignancy than those assigned to Bethesda category 4 and need for surgical intervention are comparatively lower in former than for the latter (10). The cases which are cytologically assigned to Bethesda category 3, usually need no surgical intervention but require follow up as recommended by the Bethesda system of reporting. However, cases which are cytologically classified into Bethesda category 4, need surgical intervention (lobectomy) to assess whether there is capsular or vascular invasion.

## Conclusions

Our study highlights the value of Bethesda 3 and 4 in categorization of cytologically identified TFPs in triaging thyroid lesions for lobectomy. Bethesda category 4 has sufficient predictability in identifying TFPs that need thyroid lobectomy to triage for follicular carcinoma. The Bethesda 3 and 4 carry an implied risk of malignancy comparable to the values stated for Bethesda system.

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## Antibiotic use in poultry production; a cross-sectional study in a selected district in Sri Lanka

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### ABSTRACT

**Introduction:** Rampant use of antibiotics in animal husbandry contributes significantly to the development and spread of antibiotic resistance. This study determines the antibiotic activity in poultry feed and assesses the knowledge on feeding practices and their potential effects on antimicrobial resistance among poultry farm owners.

**Methods:** Poultry feed available for sale in shops and ready to serve poultry feed and water samples from selected farms in Kegalle District, Sri Lanka were tested for the antibiotic activity using the agar well diffusion method against three control organisms; *Staphylococcus aureus* ATCC25923, *Escherichia coli* ATCC25922 and *Pseudomonas aeruginosa* ATCC27853 and the zone of inhibition around each well was measured. All farm owners were interviewed and basic details regarding the farm such as area, number of animals, water source and the awareness of farm owners regarding antibiotic use in poultry feeds and water source were obtained.

**Results:** No antibiotic activity was detected in commercially available poultry feed in selected shops (5/5) and ready to serve poultry feed in selected farms (18/18). An antibacterial effect was detected in water samples collected from 33.33% (6/18) of farms. Seventy-eight percent (14/18) of farm owners declared that they administer different types of additives containing antibiotics along with drinking water served to animals. Forty-four percent of farm owners believe that usage of antibiotics in poultry is not a good practice and harmful for human health while a similar percentage claim that it is a favorable practice as it benefits them economically. None of the farm owners were aware that the use of antibiotics in poultry can contribute to the increasing antibiotic resistance in the community.

**Conclusion:** Commercially available poultry feeds in shops and ready to serve poultry feeds in farms did not demonstrate any antibiotic activity. However, antibiotic activity was detected in drinking water served to animals due to incorporation of antibiotic containing additives beyond the prevailing guidelines. The awareness of farm owners on antibiotic use in poultry and its effects on the increase of antibiotic resistance in the community is unsatisfactory.

**Key words:** *Antimicrobial resistance, antibiotic activity, food additives, poultry feed.*

## Introduction

Poultry is the main livestock species in food production in the world as well as in Sri Lanka. Use of antibiotics as feed additive has become one of the key practices in modern poultry production as it supports growth promotion in animals and helps to treat and prevent infections in poultry. However, it contributes to the development of antibiotic resistance in both animals and humans.

More than 60% of all antibiotics produced worldwide are employed during animal production for both therapeutic and non-therapeutic purposes (1). In the United States, approximately 80% of total antibiotics consumed are used in the livestock sector (2). According to the US Food and Drug Administration, 6.1 million kilograms of medically important antibiotics were sold to US animal producers in 2019, of which 3% was being used for chicken (3).

Furthermore, a considerable portion of the administered antibiotic (17%-90%) is passed to the environment as the original compound or its toxic metabolites directly through urine and faeces. The remnants of poultry feed also contribute to environmental contamination. The emergence of antibiotic resistance genes has been reported around the world due to the misuse of these drugs in animal production (4). The antimicrobial usage in animal husbandry is projected to increase by 67%, and that of poultry by 129% by 2030 (5).

In Europe, salmonella bacteria from poultry and swine showed resistance levels reaching over 80 percent to tetracyclines, sulfonamides and ampicillin. Such data in most of the world are sparse. A study done in the Kandy district, Sri Lanka has identified some bacteria, resistant towards the tetracyclines and enrofloxacin in poultry litter and agricultural soils (6).

The World Health Organization (WHO) has called all nations to develop national strategies to minimize this serious threat of antimicrobial resistance. They have recommended to have an overall reduction in the use of all classes of medically important antimicrobials in food animals and a complete restriction of the use of antibiotics for growth promotion and for the prevention of infectious diseases. Furthermore, WHO suggests that antimicrobial agents that are categorized as

critically significant for humans should not be used to treat or control clinically diagnosed infections in farm animals (7). Sweden is known to be the first country in the world to ban the use of antimicrobial agents for growth promotion in 1986 and prophylaxis in 1988 (1). In 2017, FDA banned the use of antibiotics as growth promoters (8). At present, the only recommended growth promoters that can be used in Sri Lankan poultry industry are Avoparcin, Carbadox, and Flavophospholipol (9).

The Ministry of Health in Sri Lanka has formulated "A national strategic plan for combating antimicrobial resistance in Sri Lanka 2017 - 2022" to support global efforts to address antimicrobial resistance. Specific objective 4.3 under the 4<sup>th</sup> strategy of this will ensure the prudent use of antimicrobial agents in animals and in agriculture. Although provisions under Animal Disease Act (No. 59 of 1992) and Animal Feed Act (15 of 1986) are currently available to regulate the importation, manufacturing and distribution of antimicrobials in the veterinary sector; several gaps have been identified to fulfil the regulatory mechanism that needs to ensure the prudent use. The implementation of existing regulation is hampered due to limited resources. It is planned to establish a monitoring and evaluation system to ensure rational use of antimicrobials in animal husbandry. (10)

Therefore, the emergence of antibiotic resistance is a global challenge in which antibiotic usage in animal husbandry plays an important role. Data on antibiotic consumption in livestock is limited worldwide. Poultry farms occupy a dominant place in the livestock sector in Sri Lanka due to high consumption of chicken meat and eggs. As a result, poultry farms in Sri Lanka may be contributing vastly for the development of antimicrobial resistance both in human and animals. This study was designed to determine the antibiotic activity in poultry feeds and drinking water for animals used in poultry production in a selected district in Sri Lanka.

## Methods

A community-based descriptive cross-sectional study was carried out in poultry farms and poultry feed shops in Kegalle District, Sri Lanka in 2019.

### **Determining the antibiotic activity in poultry feed available in shops**

Two samples from two different types of poultry feed available for sale from five randomly selected shops in Kegalle District were collected into commercially available single-use sterile containers. Samples were stored at 2-8°C in the refrigerator and were transported to the microbiology laboratory in the same condition in cold boxes as soon as possible to determine the antibiotic activity using agar well diffusion method.

Mueller Hinton agar plates were inoculated with a suspension equivalent to MacFarland 0.5 turbidity standard prepared from each control organism; *Staphylococcus aureus* ATCC25923, *Escherichia coli* ATCC25922 and *Pseudomonas aeruginosa* ATCC27853. Five grams (5 g) of each food sample was mixed with 25 ml of sterile distilled water using a vortex mixture. Fifty microlitre (50 µl) each from the suspensions of food samples from one shop (in triplicate), positive control (gentamicin), and negative control (sterile distilled water) were placed in each well with a diameter of 6 mm. All plates were incubated at 35°C, 18 - 24 hours and the zone of inhibition around each well was measured in millimeters.

### **Determining the antibiotic activity of ready to serve poultry feed and water which are in poultry farms**

Eighteen poultry farms were selected from the Kegalle District based on the sample size calculation using the formula for the descriptive study (11) and the prevalence of antibiotic resistance in poultry feed used in poultry production in Galle taken as 25% (12).

Farm owners of all eighteen farms were interviewed by the principal investigator to obtain details such as the area of the farm, number of animals, feeding frequency and amount, water source, using additives containing antibiotics to water and poultry feed, and awareness of farm owners regarding antibiotic use in poultry.

Three samples of poultry feed and three water samples that are ready to serve were collected from different places of each farm. A sample from each

available additive used along with food or water was obtained. Sample collection, temporary storage, transport and testing follow the same procedure mentioned under testing of poultry feed from shops.

Five grams (5 g) of each food sample was mixed with 25 ml of sterile distilled water using a vortex mixture to prepare a suspension. From a collected water sample, 20 ml was centrifuged to separate the last 5 ml of the deposit. When the additives were available, the analysis was done from the neat sample (original concentrations) and at diluted concentrations used to feed poultry. All these samples were tested in triplicate for antibiotic activity using the agar well diffusion method.

Ethical approval was obtained from the Ethics Review Committee of the Faculty of Allied Health Sciences, University of Ruhuna, Galle and permission was obtained from the local authority.

## **Results**

### **Antibiotic activity of poultry feed available in shops**

Two types of poultry feed were available at the five selected shops in Kegalle District, one for chicks and the other for adult animals. All the tested samples did not show any antibiotic activity by the test performed against three standard organisms.

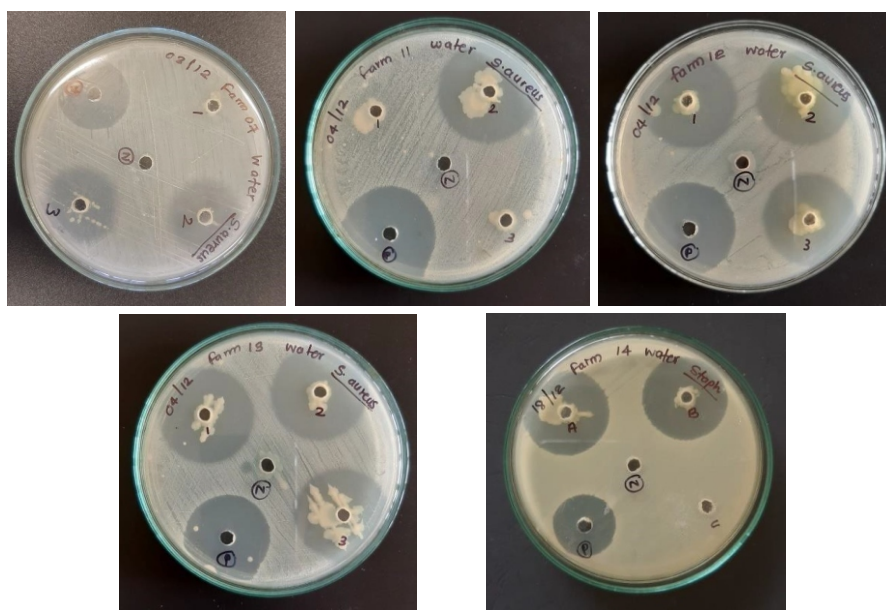
### **Antibiotic activity of ready to serve poultry feed in poultry farms**

Only chickens were raised in all the selected 18 farms. The size of the farm varies from 100 - 1500 m<sup>2</sup> (mean 672 m<sup>2</sup> (SD 362.7), median 750m<sup>2</sup>) and the number of animals in the herd ranged from 100 - 3500 (mean 1422 (SD 1133.6), median 1100). Commercially available food is being used to feed the poultry and it is served approximately 10 g of poultry feeds per animal, two times a day. All samples of poultry feed that are ready to serve did not show any antibiotic activity by the tests performed against three standard organisms.

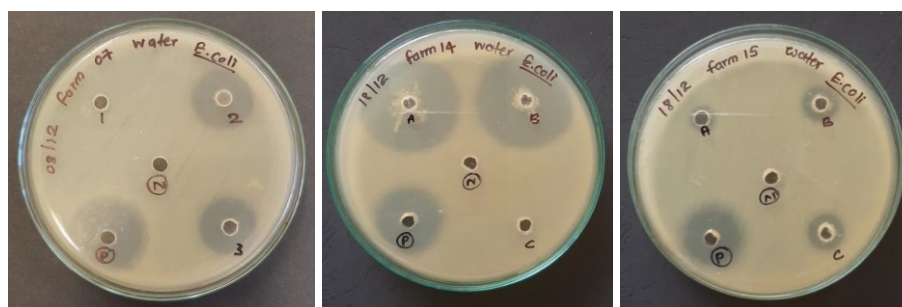
### Determining the antibiotic activity of ready to serve water in poultry farms

In most of the farms (14/18, 78%) well water is being used as the water source and the rest use pipe born water from the water supply board. Same proportion of farms (14/18, 78%) declare that they incorporate one or more additives to the water being served to

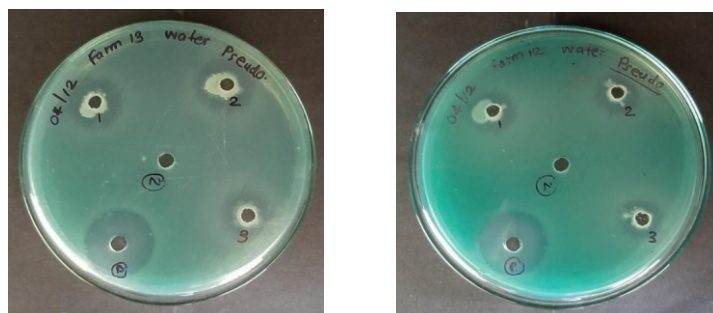
animals. Of the farms where additives are added to drinking water, antibacterial activity was detected in water samples collected from 6 farms (6/14, 42.9%). Among these, water samples from 5 farms show anti-staphylococcal activity (Figure 1), 3 farms show anti-*E. coli* activity (Figure 2) and 2 farms show antipseudomonal activity (Figure 3).



**Figure 1:** Antibiotic activity of water samples collected from farm No. 7, 11, 12, 13 and 14 against *Staphylococcus aureus* ATCC25923



**Figure 2:** Antibiotic activity of water samples collected from farm No. 7, 14 and 15 against *Escherichia coli* ATCC25922



**Figure 3:** Antibiotic activity of water samples collected from farm No. 12 & 13 against *Pseudomonas aeruginosa* ATCC27853

### Antibiotic activity of additives used along with water

The study has identified 8 different types of additives used by the farm owners that were incorporated into water to be served to the poultry (Table 1). Two of the additives (2/8) did not show any antibacterial activity. Rest of the samples (6/8) demonstrated antibacterial activity in the ready to serve concentrations of the additive used to incorporate into water served to poultry (Table 2). Out of them, comparatively higher antibiotic activity than the positive control was demonstrated by the additive number 2, 5, 6 and 7

against *Staphylococcus aureus* ATCC25923 and by the additive number 2, 5 and 7 against *Escherichia coli* ATCC25922.

Neat concentrations of only 4 additives were produced by farm owners, of which 3 has demonstrated antibacterial activity to the neat concentration. Among them the zone of inhibition detected in additives number 1 and 4 were more or less equal to the positive control indicating an equal antibiotic activity as the positive control. But zones of inhibition detected in additive number 2 was more than two times that of the positive control indicating higher antibiotic activity.

**Table 1:** Description of additives used to incorporate into water served to poultry

Additive number	Content	Remarks
1	A liquid complementary feed composed of carbonic acids and secondary plant compounds that shows some antibiotic effect	Used to improve the feed intake and the body weight gain (a growth promoter). Destroy bacterial pathogens in gastrointestinal tract.
2	100mg of Enrofloxacin (a synthetic fluoroquinolone antimicrobial agent) per 1ml	Used to treat Colibacillosis, Salmonellosis and infections caused by <i>Mycoplasma</i> species.
3	Not declared	Used to increase the body weight and to protect the farm from bacterial infections. Controls the bad odour of cages when sprayed on the cage floor.
4	100 mg of Vitamin E and 0.5 mg of Selenium per 1ml	Used to fight muscular dystrophy, build a better immune system and enhance egg production.
5	200 g of Sulfamethazine and 40 g of Trimethoprim per 1kg	An antibiotic used to treat infections caused by Gram positive and Gram negative bacteria including <i>E. coli</i> , Salmonella and Pasteurella.
6	Tylosin (100% w/w) (a macrolide antibiotic)	Treatment of chronic respiratory diseases and necrotic enteritis caused by <i>Mycoplasma</i> species and <i>Clostridium perfringens</i> respectively.
7	Neomycin and Oxytetracycline	Used to control gastrointestinal and <i>Mycoplasma</i> infections.
8	Not declared	Use not declared

**Table 2:** Zones of inhibition measured in millimeters against three standard organisms against the neat concentration and the ready to serve concentration of additives

Additive number	<i>S. aureus</i>		<i>E. coli</i>		<i>P. aeruginosa</i>	
	Neat	Ready to serve	Neat	Ready to serve	Neat	Ready to serve
01	29	0	25	0	23	0
02	46	33	54	38	48	21
03	0	0	0	0	0	0
04	0	0	25	0	0	0
05	<i>N</i>	42	<i>N</i>	32	<i>N</i>	0
06	<i>N</i>	32	<i>N</i>	0	<i>N</i>	0
07	<i>N</i>	38	<i>N</i>	27	<i>N</i>	16
08	<i>N</i>	0	<i>N</i>	0	<i>N</i>	0
Negative control	0	0	0	0	0	0
Positive control	23 - 25	23 - 30	21 - 24	21 - 22	17 - 22	17 - 21

*N* - Not available for testing

Negative controls - zone of inhibition in all tests were zero

Positive controls - zone of inhibition given as a range as each additive was tested separately

Neat concentration - original concentration

### Information gathered from poultry farm owners

All farms perform a complete cleaning process once in 30 - 45 days after one whole batch of animals are sent to slaughter and before purchasing a new batch of chicks. First, Bramble which is applied on the floor is removed completely and the cages are cleaned using a disinfectant and left for 2 - 3 days. Next, slaked lime is applied on the floor and kept for 10-15 days for total decontamination. The outside environment of the cages and containers which are used for serve feed and water are thoroughly cleaned.

All selected farms have not reported any disease for past three months at the time of the visit. All farm owners claim that the farms are visited regularly by a public health inspector. When animals get ill they seek the advice from a veterinary surgeon and in the case when an animal is found dead, they are buried without selling for meat. Chicken stool collected in the farms is sold or being used as a fertilizer.

In most of the farms (15/18) all activities in the farm are carried out by the farm owner and his/ her family members and only in 3 farms there were two

extra workers in each. Safety precautions such as wearing gloves and masks are followed by workers only in 11 farms (61%). Forty-four percent of farm owners (08/18) believe that routine use of antibiotics in poultry is not a good practice and harmful for human health. Similar percentage of farm owners' (44%) declared that routine use of antibiotics in poultry is a favourable practice as it benefits them economically. None of the farm owners who responded (16/16) were aware on the effects of using antibiotics in poultry on increasing antibiotic resistance in the community.

### Discussion

Food samples collected from shops in Kegalle district as well as ready to serve food samples collected from farms in Kegalle district did not show any antibacterial action against *Staphylococcus aureus* ATCC25923, *Escherichia coli* ATCC25922 and *Pseudomonas aeruginosa* ATCC27853. This verifies that poultry feed itself may not contain any antibiotic substances and such additives are

not being added to food before it is served to animals at the poultry farms.

But water samples collected from 33% of farms has demonstrated antibacterial effect against one or more of the above standard organisms, emphasizing that antibiotics are given to animals along with served drinking water. This study has identified eight additives being incorporated into drinking water of poultry out of which 62.5% containing antibiotics. The antibiotic activity of the concentration of some additives used in the served water samples in some farms are higher than that the positive control indicating a significantly higher antibiotic concentrations are being fed to poultry.

A study done by the Johns Hopkins University Bloomberg School of Public Health demonstrate the presence of residues of 2-10 antibiotics and 7 other medications in feather meal samples; a type poultry feed made out from feathers of killed poultry. They also showed that these residual concentrations are high enough to select the resistant bacterial strains when tested against *E. coli*. (8)

It is found that high antibiotic residues were present in 40% of samples taken from commercially manufactured poultry feed in the Delhi-National Capital Region of which 17% had multiple antibiotics (2).

Although the WHO has prohibited the application of antibiotics as growth promoters in food animal production sector, Sri Lanka still allows the use of antibiotics; avoparcin, carbadox, and flavophospholipol as growth promoters in poultry sector (9). In routine practice, different commercial products; with different trade names are used in poultry farms as growth promoters. Not only in Sri Lanka but also in India, antibiotics are being used as growth promoters across the country highlighting India as one of the global hotspots for antibacterial resistance (13).

The poultry farms in Kegalle District use several antibiotics namely enrofloxacin by 3 farms, sulfamethazine by 3 farms, trimethoprim by 3 farms, tylosin by 2 farms, neomycin by 4 farms and oxytetracycline by 4 farms with the aim of preventing and treating several bacterial infections. Most of them are used in farms daily or once in a week or monthly. In North America, antibiotics

such as tetracycline, bacitracin, tylosin, salinomycin, virginiamycin and bambarmycin are widely used. Also in the United States, tetracyclines are the most commonly used drug which exceeds two-thirds of the total amount of drugs given to animals (14).

The WHO's list of critically important antibiotics for human health includes ampicillin, amoxicillin, cefadroxil, chlortetracycline, doxycycline, erythromycin, flumequine, gentamicin, vencomycin, oxytetracycline, spiramycin, sulfadiazine and sulfadimethoxine which are restricted to use in the veterinary sector (13). But still, Oxytetracycline is used in 4 farms out of 18 farms (22.2%) in Kegalle district. In contrast, in India 11 such antibiotics were found in the chicken feed (2).

Proper guidelines regarding the types of antibiotics and their minimum and maximum amounts to be used for treating several diseases have not yet been formulated in Sri Lanka. Therefore, several drugs are used for treatment and prophylaxis in farms without considering any limitation due to unrestricted sale and over the counter availability of antibiotics in Sri Lanka. Left over water fed to animals containing antimicrobial residues can contaminate the environment via poultry stools, soil and ground water. This factor may also contribute for the emergence of antibiotic resistant strains in the community.

## Conclusions and recommendations

Commercially available poultry feeds in shops and ready to serve in poultry feeds in farms in Kegalle District did not demonstrate any antibacterial activity. But drinking water served to animals in poultry farms in Kegalle District exhibit antibacterial activity due to incorporation of antibiotics containing additives. Antibiotics are used in the poultry sector as growth promoters and for prophylaxis and treatment of infections beyond the prevailing national and international standards. A significant percentage of farm owners claim that usage of antibiotics in poultry is a favourable practice as it benefits them economically. The awareness of farm owners on the contribution antibiotic use in poultry to the development of antibiotic resistance in the community is not satisfactory.



National guidelines should be developed to regulate the use of antibiotics as growth promoters declaring the types of antibiotics with their specific concentrations and the maximum residue limits for antimicrobials in poultry products. The prophylactic and sub-therapeutic use of antibiotics in poultry should be banned. A surveillance system should be implemented to monitor these practices as well as to monitor the antibiotic resistance pattern in livestock. Poultry farmers as well as consumers should be educated on the dangers of antibiotic resistance.

### Limitations

Some poultry farm owners did not declare all the types of additives they used. Acts, regulations and guidelines regarding the usage of antibiotics in the poultry sector in Sri Lanka were very difficult to find as those data were not freely available.

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# An unusual presentation of Behçet's disease with inferior vena cava thrombosis and pulmonary embolism

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## Introduction

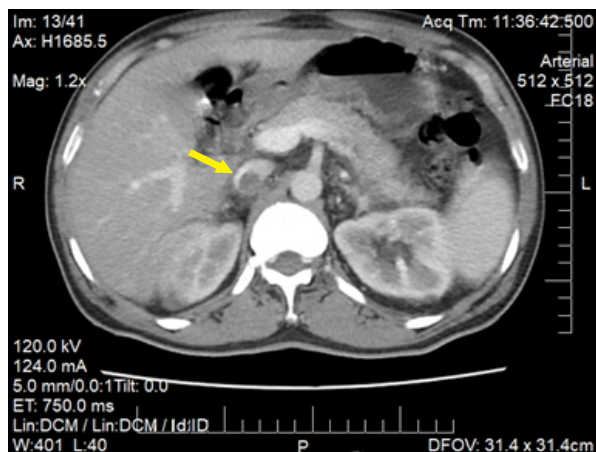
Behçet's disease (BD) is a variable vasculitis which can affect vessels of all sizes and types. It commonly affects superficial veins and is triggered by environmental factors and infections in predisposed individuals (1, 2). It is more prevalent among silk route descendants (1, 3). The Classical triad of Behçet's syndrome are oral ulcers, genital ulcers and eye involvement (1). But it can involve multi-organ systems including central nervous system, eyes, joints, gastrointestinal system and respiratory system (1, 3, 4).

Initial presentation with inferior vena cava (IVC) thrombosis that extend up to the right atrium causing pulmonary embolism is rare (5). Thrombus formation in the vessels is due to inflammatory process causing the endothelial damage. Therefore, the thrombus is tightly adherent to the vessel wall. It makes the pulmonary thromboembolism extremely rare. In this case report we present a rare occurrence of IVC thrombosis extending up to the right atrium and concurrent occurrence of pulmonary embolism.

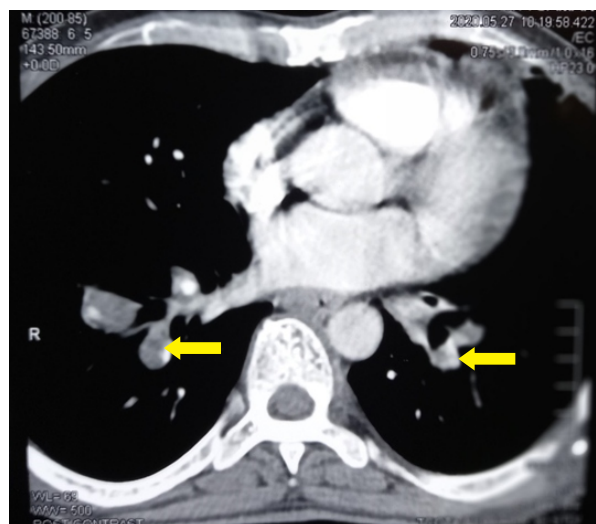
## Case presentation

A 46-year-old male presented with cough for 4 months, loss of appetite and loss of weight for 2 months duration. He had recurrent oral ulcers and papular pustular lesions in the body for 1 year duration and scrotal ulcers for 3 months duration. He was investigated for pyrexia of unknown origin 2 months back and was treated as having pyelonephritis on the right side, but urine culture was negative then. One scrotal ulcer had healed

with scarring. At the presentation to us, he had dilated superficial abdominal veins which were draining upward after emptying with mild ankle oedema, suggestive of inferior vena cava obstruction. Following day two of the admission, he developed haemoptysis and shortness of breath categorized as grade II according to modified Medical Research Council dyspnoea (mMRC) scale. Inflammatory markers were elevated (CRP 39.4 mg/dL, ESR 122 mm/hr). Coagulation studies were normal (INR 1.33, APTT 29.1 seconds). USS abdomen showed mild splenomegaly and IVC thrombus extending up to right atrium which was confirmed by contrast enhanced-CT of abdomen (Figure 1). Trans thoracic echo was normal and there was no thrombus formation within the right atrium. Computed Tomography Pulmonary Angiogram (CTPA) revealed a filling defect at the bifurcation of right pulmonary artery to lower lobe of the right lung and multiple filling defects were noted in the segmental branches of the pulmonary arteries of both lungs suggestive of pulmonary embolism (Figure 2). There were no arterial thickening and aneurysm formation. Sputum AFB and Mantoux were negative. Retroviral studies and HSV studies were negative. Reactivity of skin to needle prick or injection (Pathergy test) was negative (2). All the tumour markers were negative including tPSA, AFP, CA 19.9 and alpha-fetoproteins. Antiphospholipid antibodies were negative. Serum protein electrophoresis did not reveal a monoclonal band. The patient was diagnosed as having BD according to International Criteria for Behçet's Disease (ICBD) (Table 1).



**Figure 1:** Contrast enhanced CT abdomen revealed IVC thrombus (arrow)



**Figure 2:** Multiple filling defects (arrows) in CTPA

From day 3 of admission, warfarin 5 mg daily dose was started with the target INR of 2 to 3 to prevent the propagation of the thrombus. Subcutaneous enoxaparin 40 mg daily dose was started simultaneously and continued till the target INR was achieved. Induction of immunosuppression was done by IV methyl prednisolone 500 mg daily from day 5 of admission for 3 days and followed by oral prednisolone 1 mg/kg/day. Intravenous (IV) cyclophosphamide 500 mg 2 weekly pulse therapy was started from day 8 of admission. The patient was discharged after 3 weeks of hospital stay and reviewed 2 weekly till the completion of 5 cycles of IV cyclophosphamide pulses. Then, a daily dose of azathioprine 25 mg was added and oral prednisolone

was gradually tailed off over next 3 months. Repeat imaging of the abdomen following 3 months of diagnosis revealed the complete resolution of IVC thrombus. Oral anticoagulation was withheld after completion of 3 months. Patient is clinically well on oral prednisolone 10 mg daily and azathioprine 50 mg daily, without further relapse of the illness.

**Table 1:** International Criteria for Behçet’s disease-point score system (ICBD): scoring 4

Sign / Symptom	Points
Oral aphthosis	2
Genital aphthosis	2
Ocular lesions	2
Skin lesions	1
Vascular manifestations	1
Neurological manifestations	1
Positive pathology test*	1*

\* Pathergy test is optional and the primary scoring system does not include pathergy testing. However, where pathergy testing is conducted one extra point may be assigned for a positive result.

### Discussion

Our patient was investigated for pyrexia of unknown origin and had been treated for right side culture negative pyelonephritis, two months back, which may be the triggering factor for his disease manifestation. He had recurrent oral ulcers and he fulfilled other two criteria of BD including genital ulcers and recurrent papular pustular skin lesions (2). According to ICBD, he had 6 points with genital aphthosis, oral aphthosis, skin lesion and vascular manifestations which made him a certain case of BD (2). Though BD can affect any size and any type of vessel, it commonly affects superficial veins (3). In our patient there was IVC thrombosis which extended up to the opening of the right atrium. In BD, thrombosis formation is due to endothelial damage and platelet aggregation (3). So, thrombus is tightly adherent to the vessel wall (5). Common pulmonary involvements are pulmonary artery aneurysms and in situ thrombus formation (1, 5).

BD is rarely associated with pulmonary embolism (5). Anticoagulation therapy for in-situ pulmonary thrombus will lead to catastrophic sequelae with worsening of haemoptysis as thrombi are well organised due to vasculitis (3). Our patient well tolerated anticoagulation therapy which further supported our diagnosis. Tekantapeh S *et al.*, reported a similar case of a patient presented with haemoptysis due to BD complicated with pulmonary embolism (5). He was also successfully managed with warfarin and enoxaparin at the acute presentation and was started on immunosuppressive and immunomodulatory treatment with prednisolone, methotrexate and cyclophosphamide monthly pulse therapy which led to a complete remission. This rare presentation highlights the importance of identification of rare presentations of the BD and starting the treatment at correct time.

Authors declare no conflicts of interest. Informed written consent was obtained from the patient for publication of this case report.

#### Acknowledgements

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## Kawasaki-like disease and myocarditis in a child with recent COVID-19 infection


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### Introduction

The pandemic of COVID-19 caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS CoV-2) has led to a global threat infecting individuals of all ages. It has resulted in more than 176 million confirmed cases and over three million deaths worldwide (1). In Sri Lanka, there are more than 175,000 diagnosed COVID-19 cases and still in the rise. Severe interstitial pneumonia and hyper-activation of the inflammatory cascade are commonly seen in adults, while respiratory involvement is minimal in children.

The children with COVID-19 infection show atypical presentations with inflammatory syndromes similar to Kawasaki Disease (KD), making it difficult to understand the spectrum of COVID-19 disease in children (2). Kawasaki disease is a vasculitis of medium calibre vessels that usually affects children and the aetiology is unclear but thought to be post infectious. Common presentations of KD are fever, non-exudative conjunctivitis, cervical lymphadenopathy, polymorphous rash, peripheral oedema, red lips and strawberry tongue.

### Case presentation

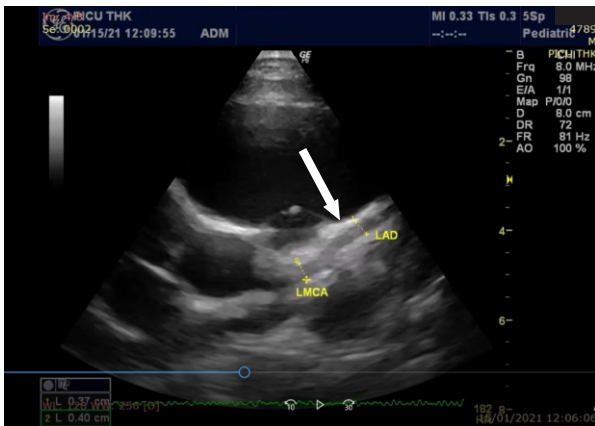
A seven-year-old boy from Kalmunai - a COVID-19 endemic area in the Eastern province of Sri Lanka was admitted to the local base hospital; with fever, cough, abdominal pain, vomiting and erythematous rash for three days. On admission he was febrile, tachycardic (140 /bpm), tachypnoeic (42/min) and had low volume pulse with a blood pressure of

70/40 mmHg. (Height adjusted 50<sup>th</sup> centile blood pressure 92/55 mmHg)

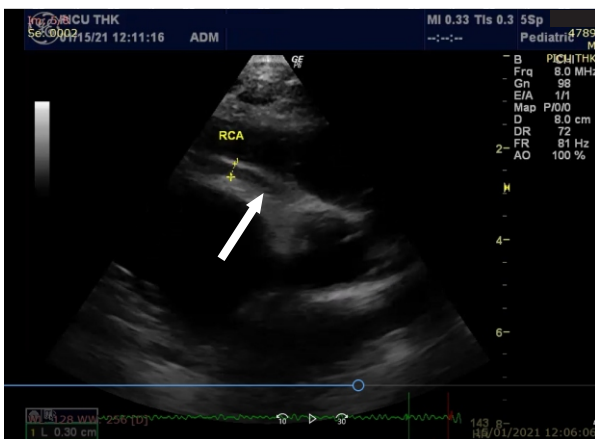
His father was treated for COVID-19 infection two weeks prior to the child's presentation, where the child had close contact. Child's PCR for COVID-19 was negative then.

Laboratory results revealed total white cell count of  $8.82 \times 10^9/L$  with 90% neutrophils, haemoglobin of 11.8 g/dL, platelets of  $87 \times 10^9/L$  with elevated C-reactive protein of 97 mg/dL and ESR of 78 mm/hr. He had hyponatraemia of 130 meq/L, renal functions were normal but had marginally elevated liver enzymes (AST 47 U/L and ALT 61 U/L). There was no growth in blood culture. His electrocardiogram (ECG) showed sinus tachycardia with nonspecific ST segment and T wave abnormalities were suggestive of myocarditis. First 2D echo-cardiogram performed at the local hospital revealed severe left ventricular dysfunction, dilated left ventricle and mild mitral regurgitation which further supported the diagnosis of myocarditis. His troponin I titre was high (207.6 ng/L).

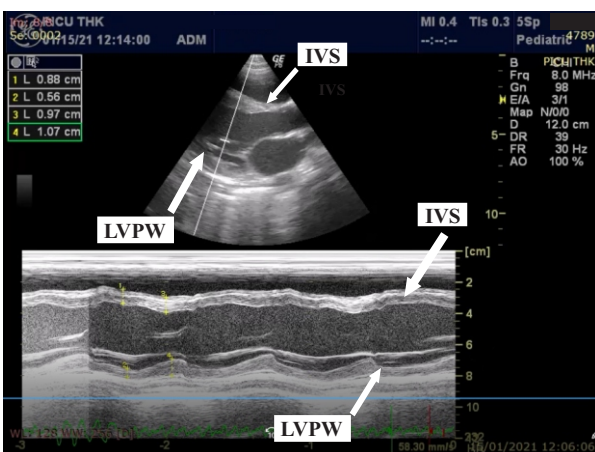
He was transferred to the Paediatric Intensive Care Unit (PICU) at Teaching Hospital Karapitiya (THK) on the sixth day of the illness. Echo-cardiogram performed on the same day showed evidence of reduced ventricular function and dilated coronary arteries. Left main coronary artery, left anterior descending artery and right coronary artery measured 4 mm (normal 1.84 - 3.2), 3.7 mm (normal 1.29 - 2.84) and 3mm (normal 1.17 - 2.94) respectively (Figures 1, 2, 3 & 4).



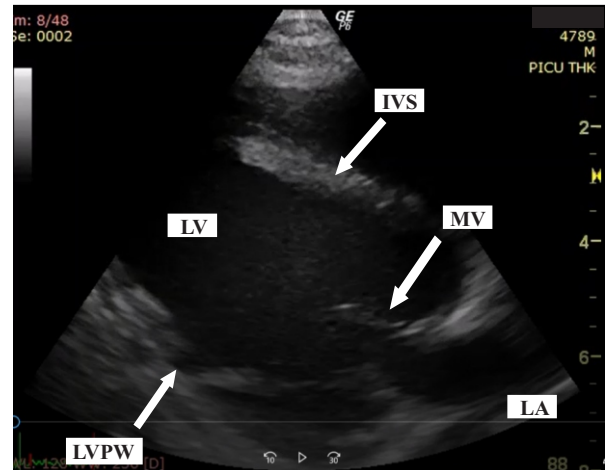
**Figure 1:** Dilated coronaries of left main coronary artery (LMCA) 4 mm and left anterior descending artery (LAD) 3.7 mm



**Figure 2:** Right coronary artery (RCA) 3 mm



**Figure 3:** M-Mode of echocardiogram showing an ejection fraction of 40% on acute stage (Normal range 65 - 70%) LVPW - Left ventricular posterior wall, IVS - Interventricular septum



**Figure 4:** 2D Echocardiogram of left ventricle shows dilated left ventricle (LV), IVS - Interventricular septum, LVPW - Left ventricular posterior wall, LA - Left atrium, MV - Mitral valve

He needed dopamine-titrated 10 µg/kg/min - for pressure support and was treated with a single dose of intravenous immunoglobulin (IVIG - 2 g/kg) followed by methylprednisolone (30 mg/kg/day) and anti-inflammatory dose of aspirin (75 mg/kg/day). His improvement was remarkable; fever subsided after 24 hours of treatment. Haemodynamic parameters were stable enough to discontinue inotropes 48 hours after the treatment. Inflammatory markers reduced with clinical improvement. CRP dropped to 71 mg/dL and ESR to 80 mm/hr and platelet count increased up to 220 x 10<sup>9</sup>/L in 3 days after the treatment (day 9<sup>th</sup> of the illness). Methylprednisolone and anti-inflammatory dose of aspirin was stopped. Aspirin was continued as an anti-platelet - 5 mg/kg/day- dose. A Repeat 2D echo-cardiogram, one week after previous study showed improvement of coronary artery dilatation and significant recovery of left ventricular function. Repeat investigations, 10 days after the treatment showed CRP of 12 mg/dL, ESR of 50 mm/hr and platelet count of 550 x 10<sup>9</sup>/L. Liver enzymes showed normal values. The patient was discharged home on an antiplatelet dose of aspirin (5 mg/kg/day) with a plan to follow up at paediatric cardiology clinic. Follow up 2D Echo-cardiogram at six weeks after the discharge showed normal coronaries with normal cardiac function. Therefore, aspirin was stopped and planned to review in 3 months.

Repeat COVID-19 PCR done at THK on the sixth day of the illness was negative; both IgG and IgM antibodies done on the ninth day of the illness were positive for COVID-19 infection.

**Discussion**

The first published case of Kawasaki disease and COVID-19 infection was reported in a 6-month-old child in Wuhan, China in early 2020 with five days of fever and typical clinical findings meeting criteria for classic Kawasaki disease (3). There were similar cases reported in Europe, Pakistan, North America that had been associated with positive PCR for COVID-19.

Children with hyper-inflammatory shock, showing features similar to atypical Kawasaki, Kawasaki disease shock syndrome, or toxic shock syndrome were reported in mid 2020. Multisystem inflammatory syndrome in children (MIS-C) is a rare condition that has been reported 2 - 4 weeks after the onset of COVID-19.

Recently, reports from Europe and North America have described clusters of children and adolescents requiring admission to intensive care units with a multi system inflammatory condition with some features similar to those of Kawasaki disease and toxic shock syndrome (4, 5). They describe a presentation of acute illness accompanied by a hyper inflammatory syndrome, leading to multi organ failure and shock. Those patients have presented with fever, variable rash, conjunctivitis, peripheral oedema, significant gastrointestinal symptoms, shock, and elevated inflammatory markers and elevated cardiac markers. All children were negative for SARS-CoV-2- RT- PCR, but had positive antibodies for COVID-19 (4, 5).

This is the first reported case of Kawasaki Shock Syndrome - Multisystem Inflammatory Syndrome in Children (MIS-C) following COVID-19 infection in a child in Sri Lanka.

World Health Organization (WHO) has developed a preliminary case definition for MIS-C (Table 1). The case definition will be revised as more data will become available (6).

**Table 1:** Preliminary case definition of MIS-C

<b>Children and adolescents 0 - 19 years with fever <math>\geq</math> 3 days</b>
<b>AND two</b> of the following:
<ol style="list-style-type: none"> <li>1. Rash or bilateral non-purulent conjunctivitis or muco-cutaneous inflammation signs (oral, hands or feet).</li> <li>2. Hypotension or shock.</li> <li>3. Features of myocardial dysfunction, pericarditis, valvulitis, or coronary abnormalities (including ECHO findings or elevated Troponin/NT-pro-BNP),</li> <li>4. Evidence of coagulopathy (by PT, PTT, elevated D-dimers).</li> <li>5. Acute gastrointestinal problems (diarrhoea, vomiting, or abdominal pain)</li> </ol>
<b>AND</b>
Elevated inflammatory markers (ESR/ C-reactive protein/ procalcitonin).
<b>AND</b>
No other diagnosis microbial cause of inflammation, including bacterial sepsis, staphylococcal or streptococcal shock syndromes.
<b>AND</b>
Evidence of COVID-19 (RT-PCR, antigen test or serology positive), or likely contact with patients with COVID-19.

According to this new case definition of MIS-C following COVID 19 infection, the child in our case report has complied with criteria to diagnose MIS-C.

### Conclusions

Physicians' understanding of the myriad of COVID-19 presentations, is vital to reduce morbidity and mortality through early diagnosis and effective treatment. This case report warrants the need of further research on the diverse spectrum of clinical presentations of COVID-19 in the pediatric population.

If a child who recovered from COVID-19 infection shows fever, variable rash, conjunctivitis, peripheral oedema, significant gastrointestinal symptoms, medical advice should be sought.

The authors declare no conflicts of interest in presenting this case. No sources of funding.

Informed consent has been obtained from parents of the child to publish this case report.

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