

# PROCEEDINGS



Annual Scientific Sessions  
of The Nutrition Society of Sri Lanka

# 2021

23<sup>rd</sup> – 24<sup>th</sup> January 2021

**Proceedings**

*of the*

**Annual Scientific Sessions**

*of*

**The Nutrition Society of Sri Lanka**

**'Together We Build a Healthy Nation with Better Nutrition'**

**23<sup>rd</sup> - 24<sup>th</sup> January 2021**

**Proceedings of The Nutrition Society of Sri Lanka - January 23-24, 2021**

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**Annual Scientific Sessions of The Nutrition Society of Sri Lanka**  
**23<sup>rd</sup> - 24<sup>th</sup> January 2021**  
**VIRTUAL CONFERENCE**



**DAY 1: Saturday 23<sup>rd</sup> January 2021**

<b>Time</b>	<b>Event</b>
8.30 a.m.	Lighting of oil lamp & National anthem
8.40 a.m.	<b>Welcome Speech</b> <i>Prof. Chandima Wickramatilake, President, NSSL</i>
8.50 a.m.	<b>Address by the Chief Guest</b> <i>Dr. Seetha Arambepola</i> Hon State Minister, State Ministry of Skills Development, Vocational Education, Research & Innovations
9.10 a.m.	<b>Keynote Address</b> <i>Dr. Angela de Silva</i> Regional Adviser, Nutrition and Health for Development, WHO Regional Office for South East Asia
9.55 a.m.	<b>Presidential Address</b> <i>Prof. Chandima Wickramatilake, President, NSSL</i>
10.15 a.m.	<b>Vote of Thanks</b> <i>Dr. Ananda Chandrasekara, Joint Secretary, NSSL</i>
10.20 a.m.	<b>CULTURAL EVENT &amp; COMFORT BREAK</b>
10.30 a.m.	<b>Symposium 1</b> <b>Stimulants, Addictions &amp; Behavioural Change in Nutrition</b> Symposium Chair : <i>Dr. Dhammika Senanayake, Vice President, NSSL</i>
	<b>Plenary Lecture</b> <b>Behavioural Change in Health &amp; Nutrition</b> <i>Dr. I. Harshani Rajapakse, Senior Lecturer, Department of Psychiatry, Faculty of Medicine, University of Ruhuna</i>
	<b>Symposium Lecture</b> Dietary Supplements, Stimulants & Doping <i>Vidyajothi Senior Prof. Arjuna. P. de Silva, Department of Medicine, Faculty of Medicine, University of Kelaniya</i>
	<b>Symposium Lecture</b> <b>Role of Public Sector in the Prevention of Addictions</b> <i>Dr. Lakanath Welagedara, Consultant Physician, Teaching Hospital Colombo South, Chairman, National Dangerous Drugs Control Board</i>
	<b>Panel Discussion</b>

11.40 a. m.	<p><b>Symposium 2</b>  <b>Role of Development Sector in Nutritional Wellbeing</b>                  Session Chair: <i>Mrs. R.P.M. Sandamali, Joint Secretary, NSSL</i></p>
	<p><b>Plenary Lecture</b>  <b>Shared Vision in Policy Making for a Better Nutrition</b>  <i>Dr. Lakmini Magodaratne, Nutrition Division, Ministry of Health</i></p>
	<p><b>Symposium Lecture</b>  <b>Community Empowerment: Are we on the Right Track?</b>  <i>Miss. Visakha Tillekeratne, Consultant Food Technologist and Nutrition Expert</i></p>
	<p><b>Symposium Lecture</b>  <b>Scaling Up Multi Sectoral Nutrition</b>  <i>Mrs. Dilka Peiris, Project Director, Scaling Up Nutrition People's Forum</i></p>
	<p><b>Panel Discussion</b></p>
12.50 p.m.	<b>LUNCH BREAK</b>
1.30 p.m.	<p><b>Flash Talks on Free Communications</b>                  Session Chairs: <i>Dr. Champa Wijesighe, Mrs. Hasanga Rathnayake, Mrs. Eranga Silva, Council Member, NSSL</i></p>
3.30 p.m.	<b>End of the Day</b>
<p><b>Annual Scientific Sessions of The Nutrition Society of Sri Lanka</b>  <b>23<sup>rd</sup> - 24<sup>th</sup> January 2021</b>  <b>VIRTUAL CONFERENCE</b>  <b>DAY 2: Sunday 24<sup>th</sup> January 2021</b></p>	
	
<b>Time</b>	<b>Event</b>
8.30 a.m.	<p><b>Symposium 3</b>  <b>Nutraceuticals in Nutrition</b>                  Symposium Chair: <i>Dr. Ananda Chandrasekara, Joint Secretary, NSSL</i></p>
	<p><b>Symposium Lecture</b>  <b>Preclinical &amp; Clinical Trials of Nutraceuticals for Diabetes</b>  <i>Prof. Catherine B. Chan, Professor in Nutrition and Physiology, University of Alberta, Canada</i></p>
	<p><b>Symposium Lecture</b>  <b>Advances in Delivery Systems for Bioactives</b>  <i>Prof. Feral Temelli, Professor in Food Process Engineering, Department of Agricultural, Food and Nutritional Science, Agriculture/Forestry Centre, University of Alberta., Canada</i></p>

	<b>Panel Discussion</b>
9.20 a.m.	<b>Prof. C.C. De Silva Memorial Lecture</b> <b>“Women &amp; Diabetes : The Sri Lankan Perspectives for 21<sup>st</sup> Century”</b> <i>Prof. Chandrika N Wijeyaratne, The Vice Chancellor, University of Colombo</i>
10.20 a.m.	<b>CULTURAL EVENT &amp; COMFORT BREAK</b>
10.35 a.m.	<b>Oral Presentations on Free Communications</b> <i>Session Chairs: Prof. Terrence Madhujith &amp; Ms. Eranga Silva, Council Members, NSSL</i>
12.30 p.m.	<b>LUNCH BREAK</b>
1.00 p.m.	<b>Symposium 4</b> <b>Food &amp; Nutrition in Natural Disasters</b> <i>Session Chair: Prof. Anoma Chandrasekara, Council Member, NSSL</i>
	<b>Plenary Lecture</b> <b>Nutritional Challenges for Future Generations</b> <i>Prof. Renuka Silva, Professor of Nutrition, Wayamba University of Sri Lanka</i>
	<b>Symposium Lecture</b> <b>Maternal &amp; Childhood Nutrition in Natural Disasters</b> <i>Senior Prof. Pujitha Wickramasinghe, Department of Paediatrics, Faculty of Medicine, University of Colombo</i>
	<b>Symposium Lecture</b> <b>Harnessing Biodiversity for Food &amp; Nutrition</b> <i>Dr. Gamini Samarasinghe, Additional Secretary, Ministry of Agriculture</i>
	<b>Panel Discussion</b>
2.15 p.m.	<b>Awards &amp; Appreciations</b>
2.30 p.m.	<b>Closing Remarks</b> <i>Prof. Terrence Madhujith, Conference Chair – Annual Scientific Sessions</i>
2.45 p.m.	<b>Annual General Meeting</b>
4.00 p.m.	<b>End of the day</b>
<b>“TOGETHER WE BUILD A HEALTHY NATION WITH BETTER NUTRITION”</b>	

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## *Message from the Chief Guest*



“Healthy citizens are the greatest asset any country can have.” – Winston Churchill.

Health and nutrition are the most important contributory factors for human resource development in a country. Nutrition related; noncommunicable diseases have become a major threat to public health. Micronutrient deficiencies such as vitamin A deficiency, Iron Deficiency, Anemia, Iodine Deficiency Disorders and vitamin B-complex deficiencies are the nutrition problems frequently encountered, particularly among the rural poor and urban slum communities and among children and women.

Nutrition is a critical part of health and development. Better nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth and lower risk of non-communicable diseases such as diabetes, cardiovascular disease and cancer. People with adequate nutrition are more productive and can create opportunities to gradually break the cycles of poverty and hunger; it is a well-known fact that healthy children learn better. Malnutrition, in every form, presents significant threats to human health. Today the world faces a double burden of malnutrition that includes both under nutrition, especially in low- and middle-income countries, as well as obesity. WHO is providing scientific advice and decision-making tools that can help countries take action in order to address all forms of malnutrition to support the health and wellbeing of all, at all ages.

A healthy diet helps to protect against malnutrition in all its forms as well as combating noncommunicable diseases. Unhealthy diet and lack of physical activity are leading global risks to health. Healthy dietary practices start early in life - breastfeeding fosters healthy growth and improves cognitive development, and may have long term health benefits such as reducing the risk of becoming overweight or obese and developing Non-communicable diseases later in life.

Nutrition is a basic human need and a prerequisite to a healthy life. Nutrients that we obtain through food have vital effects on physical growth and development, maintenance of normal body function, physical activity and health. Our diet must provide all essential nutrients in the required amounts. Requirements of essential nutrients vary with age, gender, physiology and physical activity. Dietary intake status being lower or higher than the body requirements can lead to under nutrition (deficiency diseases) or over nutrition (diseases of affluence) respectively. Eating inadequate amount of food during certain significant periods of life such as infancy, childhood, adolescence, pregnancy and lactation and eating too much at any age can lead to harmful consequences. An adequate diet, providing all nutrients, is needed

throughout our lives. The nutrients must be obtained through a judicious choice and combination of a variety of foodstuff from different food groups. It is equally important to drink an adequate quantity of water.

It is important to adopt these nutritional habits which should become part of a healthy lifestyle. Although death is inevitable; extending life through good health is possible and nutrition is the key to health and longevity.

I make this short message an opportunity to wish The Nutrition Society of Sri Lanka every success in the coming years.

*Dr. Seetha Arambepola*

*Hon. State Minister of Skills Development, Vocational Education, Research and Innovation*

### ***Message from President, NSSL***



On behalf of the Council of the Nutrition Society of Sri Lanka (NSSL), it's my privilege to be a part of the Annual Scientific Sessions 2021. We as the NSSL council wanted to keep life working during COVID-19. We managed to continue our annual activities amid of all the challenges, sometimes changing the platform. We shifted the Annual Scientific Sessions the face-to face physical conference to a blended format. This became a reality amid of all uncertainties, because of my energetic council which is the strength behind me to organize the sessions in this scale.

It is my pleasure to welcome all of you who have join with us to make this endeavor as success. I offer my most grateful welcome to the chief guest Dr. Seetha Arambepola, Hon State Minister, State Ministry of Skills Development, Vocational Education, Research & Innovations, the keynote speaker, Dr. Angela de Silva, Regional Adviser Nutrition and Health for Development, WHO Regional Office for South East Asia, symposium speakers, judges, abstract reviewers, award application evaluators, presenters, visual coverage and compereing teams, life members, all the distinguish guests and the other participants who have join with us physically and online. I would like to welcome to all the sponsors who extended financial support for the event and the hosting team.

The theme of this year's sessions is "Together We Build a Healthy Nation with Better Nutrition. No single organization, professional body, ministry, no single government can act alone to achieve the ending hunger and malnutrition. Working together, is the only way to reach the goals. It is a timely topic for the county, since we are facing the triple burden of malnutrition which will be in more magnified with the prevailing COVID-19. We have selected the symposium lecture topics carefully which are appropriate to everybody and well-timed. Now it is the time for sharing knowledge, reviewing and showcasing the scientific output related to health and Nutrition. Hope you will enjoy the sessions in the most productive way.

Once again let me welcome all of you very sincerely to NSSL sessions 2021.

Wish you a pleasant day!

*Prof. Chandima Madhu Wickramatilake*  
*President, NSSL*

***Message from Joint Secretary***



It is my great pleasure to express, on behalf of the organizers and on my own behalf, a deep appreciation for the support and encouragement provided by such individuals and institutions. It gives me an immense pleasure to deliver the vote of thanks for this event to all dignitaries assembled here. I would like to thank our chief guest, Dr. Seetha Arambepola, Hon. State Minister, State Ministry of Skills Development, Vocational Education, Research & Innovations, who honored this function with her inspirational thoughts. I would like to thank the keynote speaker, Dr. Angela de Silva, Regional Adviser, Nutrition and Health for Development, WHO Regional Office for South East Asia, who is also a life member and a past-president of the society.

The main purpose of the Scientific Session is to exchange views on the novel scientific findings and research outcomes within the relevant stakeholders and public. The organization of such events are generally the result of close cooperation among several institutions and individuals. I would like to thank, Dr. Lal Ekanayake, the Director of the Institute of Sports Medicine and the supportive staff members for providing us this wonderful venue and giving us all the support to make this event successful.

I would like to thank all Symposium speakers, Judges, Abstract reviewers, Award application evaluators, awardees and all presenters. We as the council of the Nutrition Society of Sri Lanka sincerely acknowledge the generous provision of the sponsors, without their support this event would have not been a reality.

- Asian Palm Oil Processing (Pvt), Maragahadeniya, Baduraliya being the gold sponsor of the event.
- The Co-Sponsors, Biomedite Pvt Ltd, Kalubowila, Dehiwala
- The Co-Sponsors, Transmed International Pvt Ltd, Madiwela Road, Embuldeniya, Nugegoda

I express my sincere thanks to the hosting team, visual coverage and compering teams for making this function a successful one. It has been a real pleasure to work with these very fine and capable group of people.

My sincere thanks to all the delegates, including other distinguish guests and the participants, members of the NSSL, who are the reason of this event. This is a unique opportunity to learn from the world's best experts in Nutrition and Health. I promise that you will not be disappointed.

Finally, I must mention the support provided by the council members of the NSSL Including the President. I must say that their contribution has been invaluable and indispensable for this project during this difficult period. Thank you, team, without our collective effort, we would have achieved little.

If I missed any other institutions and individuals who have been supporting us during this task, I wish to be forgiven for not specifically expressing our gratitude.

Thank you all.

*Dr. Ananda Chandrasekara*  
*Joint Secretary, NSSL*

*Message from the Conference Chair, Annual Scientific Sessions - 2021*



It is with great pleasure that I write this message as the symposium chair of the Annual Scientific Sessions of the Nutrition Society of Sri Lanka (NSSL).

The Nutrition Society of Sri Lanka is committed to establish links among nutritionists, healthcare professionals, scientists and other parties interested in nutrition, advocate nutritional education among Sri Lankans with the aim of promoting nutritional status of the country. The Annual Scientific Sessions of the Nutrition Society of Sri Lanka is the main scientific forum where the research findings relating to nutrition and allied sciences are presented. The forum provides an ideal platform for the nutrition professionals to meet, discuss and debate nutrition related research findings and advancement of nutrition science. Organizing the annual scientific sessions was severely challenged by the pandemic that has been fast spreading across the world. The council of the NSSL was determined to hold the sessions amidst the obstacles faced during the past year. Finally, the council agreed to hold the sessions virtually which was a great deal of novel experience for the society.

This year, in response to the call for abstracts, more than 45 synopses were received, of which the best were selected for the sessions following a rigorous review process. Given the limited time in the two day forum, the number of oral presentations were limited to ten and the rest of the submissions were accommodated as three minutes flash talks. The presentations span over a wide continuum of areas relating to nutrition and allied sciences. All the presentations were pre-recorded in order to avoid interruptions during the past few weeks.

The Annual Scientific Sessions of the NSSL - 2021 under the theme of 'Together we build a healthy nation with better nutrition' has become a great success due to indefatigable efforts and generous assistance of many. I wish to express my sincere gratitude to Dr. Seetha Arambepola, Hon State Minister, State Ministry of Skills Development, Vocational Education, Research & Innovations, the keynote speaker, Dr. Angela de Silva, Regional Adviser Nutrition and Health for Development, WHO Regional Office for South East Asia, symposium speakers, judges, abstract reviewers, award application evaluators, presenters. Special thanks are due to Prof. Feral Temelli and Prof. Catherine Chan from University of Alberta, Canada for contributing to the symposium and Ms. Brasathe Jeganathan, University of Alberta, Canada for connecting them with me. I am grateful to Dr. Lal Ekanayake, the Director of the Institute of Sports



Medicine and the supportive staff members for providing us the venue for coordinating the activities of the event. Thanks are also due to Mr. Kapila Bandara and his team who made the transformation of physical event to a virtual a reality by providing technical assistance. I appreciate Mr. T.C. Tennakoon, Senior Director, Noritake Lanka Porcelain (Pvt) Limited, Matale for his generous support and printing mugs at a short notice. The event would have been impossible without the generous financial assistance of sponsors.

*Prof. Terrence Madhujith*  
*Conference Chair - Annual Scientific Sessions of the NSSL- 2021*

## ***Keynote Address***

### **Multisectoral approaches to support nutrition; challenges, opportunities and strategies for the future**



***Dr. Angela de Silva***

*Regional Adviser, Nutrition and Health for Development, WHO Regional Office for South East Asia*

Investing in nutrition is shown to improve outcomes in maternal and child health, cognitive function, human capital, economic growth and poverty reduction. Though traditionally, nutrition programmes have been the responsibility of health or agriculture sectors, the involvement and contribution of multiple sectors is important. Global momentum, initiated by the ICN 2 commitments and framework is bringing agriculture, food security, and nutrition closer together and has promoted more coordination between these sectors for improvement of population nutrition. The sustainable development goal on nutrition further promotes the concept of multi-sectorality- without improvement in agriculture that takes into consideration nutrition security and is sustainable, the SDG nutrition targets will not be achievable.

Nutrition is a multisectoral problem with multisectoral dimensions and solutions. The immediate causes are related to food and nutrient intake and to health. The underlying causes are embedded in the household, health and community context in which malnutrition occurs. The underlying causes are further impacted by agricultural practices, lack of access to and availability of clean water and sanitation, female education, and social protection and social safety nets.

This keynote address describes and contextualizes the food and nutrition situation in Sri Lanka, and in doing so, provides evidence that a true multisectoral approach is a critical dimension in the improvement in nutrition status of the population. It describes the evidence for this assertion, and describes the key operational areas and aspects of multisectoral approaches to nutrition which would yield positive nutrition outcomes.

This address contributes to the academic sessions by sharing information and experiences that can contribute to the solution of important multisectoral issues. Although there is plenty of literature/reports demonstrating the importance of linking nutrition and other sectors, little knowledge exists on translating this knowledge in to practice. Therefore, this address also explores the question on what a multi-sectoral approach to nutrition means in practice and offers some data and evidence of the better outcomes seen when specific strategies are used to

promote and support multisectoral involvement in nutrition actions and programmes. By drawing upon personal experiences of multisectoral actions across the Asia region, recently published reports and documents on multisectoral processes and nutrition, this talk reviews the data on the impact on nutrition when specific multisectoral processes are taken into consideration; identifies the major failures and challenges in multisectoral programming, and poses questions on possible opportunities for improving food and nutrition in Sri Lanka through multisectoral processes.

## *Presidential Address*

### **Ethics in Research during COVID-19 Pandemic: Bin it or Pin it?**

*Prof. Chandima Madhu Wickramatilake*  
*President, NSSL*

Coronavirus disease 2019 (COVID-19) pandemic has placed an extraordinary burden on health system and many other systems all over the world.<sup>1</sup> The pandemic raised a number of unprecedented challenging ethical issues not only in patient care but also in research; clinical studies, clinical trials and innovations during the pandemic.<sup>2</sup> Moreover, it has been declared as a global health emergency.

COVID-19 has become one of the biggest health concerns, along with huge economic burden due to the rapid increase in the number of patients and the alarmingly rising number of deaths globally. At the same time there is no clear remedies to treat the disease or to prevent the diseases, until recent past when the reasonably good vaccinations were introduced. Meanwhile unusual and unproven alternate remedies have claimed the lives of patients based on information disseminated through nonscientific sources. Because of the uncertainties in the pathology, natural course of the disease, management and the prevention of COVID-19, currently there is a big demand for research evidence which would be useful for the future as well. Furthermore, there is a huge flow of misinformation and malpractice outside the boundaries of scientific practice and standard guidelines postulated by professional bodies.<sup>3</sup>

Hence, scientific research is needed in order to improve the response to global health emergencies such as COVID-19. Therefore researchers have been working fervently to identify potential treatments and vaccines against the disease. As a result the researchers expects relaxation of the review process, than expedited review which has created undue pressure and increase burden on the Ethics Review Committees (ERC).<sup>4</sup> Nevertheless, proliferation of COVID-19 based research has led to substandard research revealing nothing worth, but wasting resources. In some of those research, presence of honest errors, limitations and presence of obvious misconduct and deception had led to disqualification, retraction, withdrawal or expression of concern on recent publication related to COVID-19.<sup>5,6</sup> Some of these manuscripts published are associated with unacceptable scientific frauds which could have led to patient harm and serious devastating consequences.<sup>7</sup>

There are fundamentals in research ethics to be adhered during any type of human research which are known as **Pillars of Ethics; autonomy, beneficence, non-maleficence and justice**. Other than the basic principles, **scientific validity and social value** of the research are also important components. Scientifically unsound research is believed to yield unreliable data and ends up with invalid conclusions. Societal value of the research highlights the contribution of the research to the well-being of the society and living of the community.<sup>8,9</sup>

**To ensure ethical research during the COVID-19** outbreak, various professional bodies have summarized the key universal ethical standards which should be followed by researchers, review bodies, funders, publishers and manufacturers, the stakeholders of the process.

- **Independent review of research proposal** through **expedited process** by ERCs, but **not compromised in quality**, particularly attention is paid to **fair consent, the safety of study participants**.

- Research methodology should be assessed for the **scientific validity** in the context of potentially scarce and stressed clinical resources during the pandemic. Careful assessment is necessary on the resources and the capacities, because the whole picture that was in the system might have changed with the health emergency. It is imperative that research **should not impede the health care response** (personnel, facilities and other resources) during the health emergency.
- Researcher should ensure that research is **responsive and sensitive to local realities, needs, values, cultures and communities**.
- Any research should show **adequate social value** to the particular community without exposing both participants and the investigators to unnecessary risk in health emergencies.
- It needs to show **fair and meaningful community engagement with inclusive and accountable decision-making**.
- **Participant selection needs to be fair** and all should be treated with **equal respect** without jeopardizing the scientific validity of the research.
- Research should elicit the **individual informed consent** process without coerciveness, **unless those are routine public health activities and related surveillance not amounting to research**.
- Participants need to be **fully informed** about the collection, storage, future use, bio-banking and export of human biological material.
- Participants should be **given access to any benefits that result from their participation**. Where interventions are found to be safe and effective, those interventions should be made available to local populations as soon as possible.<sup>10,11</sup>

Research is required more than ever during this COVID-19 global health emergency, yet crises or emergencies are no excuses for lowering scientific or ethical standards of research.

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## *Prof CC De Silva Memorial Lecture*

### **Women and Diabetes: The Sri Lankan Perspective for the 21<sup>st</sup> Century**



***Prof. Chandrika N. Wijeyaratne***  
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The global view of type 2 diabetes and pre-diabetes being the ‘mother of all diseases’ from its macrovascular and microvascular complications is personified by how it has pervaded the quality of life and well-being of South Asian populations, particularly in terms of premature disability and death. The enormity of its impact, nurtured by unhealthy lifestyle and increasing obesity, on the economic development of lower and middle-income countries requires a concerted approach in primordial prevention. The global numbers of diabetes prevalence have risen exponentially. Worldwide trends since 1980 of age-standardized diabetes prevalence has increased from 4.3% in 1980 to 9.0% in 2014 in men, and from 5.0% to 7.9% in women, with women surpassing men with advancing age. In 2019, a total of 463 million people was estimated to be living with diabetes, representing 9.3% of the global adult population (20–79 years). This is projected to increase to 578 million (10.2%) in 2030 and 700 million (10.9%) in 2045. The prevalence of diabetes in women in 2019 was estimated to be 9.0%, and 9.6% in men. The increase in diabetes prevalence with age leads to a prevalence of 19.9% in people aged 65–79 years. It is well accepted that women are not far behind men in prevalence and also recognized to suffer from more severe complications.

World Diabetes Day is observed on 14<sup>th</sup> November, since 2006. More recently the internationally agreed themes include ‘Healthy Women- Healthy Nation’ and ‘Diabetes and the Family’. Many countries struggling with the rise of type 2 diabetes have focused on the affliction of pre-diabetes and diabetes in young women.

#### **Would focusing on women’s health prove to be as a step in the right direction?**

Women lead their families in lifestyle. Hence women play an important role in encouraging families and communities to adopt healthy behaviours. The trajectory of increasing NCDs burdening the development of lower middle-income countries in the South Asian region calls for empowering women to become change agents for healthier societies.

Women and diabetes is a special problem. Women have often been overlooked and ill addressed by health systems throughout the world. Women with diabetes are in fact at a greater risk of bad outcomes of diabetes more than among men. South Asian countries have joined hands since 2013 in addressing diabetes among women, particularly in and around pregnancy.

Hyperglycemia in pregnancy (HIP) is the focus of attention today as gestational diabetes mellitus (GDM) of varying degrees of severity, detected during pregnancy has shown a parallel rise with the worldwide epidemic of type 2 diabetes and cardiovascular risks. GDM is a form of diabetes occurring during pregnancy which can result in short- and long-term adverse outcomes for women and their children. The American Diabetes Association (ADA) defines GDM as “glucose intolerance of any degree with the onset or first recognition during pregnancy, and irrespective of whether or not insulin is required or the condition persists after pregnancy”. The need for a multi-disciplinary and a life course approach with a holistic outlook to seek answers to many research questions that arose in this aspect was widely endorsed by WHO (World Health Organization), IDF (International Diabetes Federation) and FIGO (International Federation of Gynaecology and Obstetrics).

Currently GDM affects approximately 7% of all pregnancies and up to 14% of pregnancies in high-risk populations while pre-gestational diabetes mellitus is estimated to affect about 1.3%. South India reported the incidence of GDM to be 16.55%, while in Sri Lanka the incidence in the community was 10.3 %, in 2006 and 13.9% in 2016. The IDF estimates that globally 20.9 million (16.2% of live births) in 2015 had some form of maternal hyperglycaemia. GDM accounted for 85.1%, with other types of diabetes first detected during pregnancy being 7.4% and pre-pregnancy glucose intolerance 7.5%. South Asian ethnicity is a known non-modifiable risk factor for GDM.

### **How is diabetes specifically a health risk for women and their families?**

Women from early years (such as in their late 20s) have been shown to be commonly overweight and obesity that is a frightening trend. The main reasons for this are behavioural and environmental causes. Unhealthy diet in the form of food and sugar laden beverages (including tea), a woefully inadequate level of physical activity makes women more vulnerable to excess body fat. In the background of the Asian risk of developing from an early age in life due to unhealthy fat and insulin resistance, pregnancy is a stress test for diabetes. Hence when pregnancy occurs in the background of adiposity – the development of diabetes in pregnancy risk is extremely high. Our published local data at community level in Sri Lanka show a dangerously increasing trend of this phenomenon.

### **Is there a specific age when women are most at risk of getting the disease? Why?**

Although the general belief is that when one crosses the age of 40 the risk of developing diabetes increases, it is very clear that our South Asian populations from their late teens are at risk of developing pre-diabetes and diabetes. The annual conversion rates to diabetes are high among some groups, particularly young women with Polycystic Ovary Syndrome (PCOS). PCOS is also a lifestyle disease.

Our recent data shows that diabetes in pregnancy – which is the main predictor of future diabetes in women, has increased from 1 in 10 women in 2005 to 1 in every 7 women in 2016. Such changes have been observed at field level in semi urban and rural settings alike. Among older non-pregnant women, the affliction of women with diabetes matches or overtakes those of men.

### **Diabetes has no gender bias**



Pregnancy is a window period to look into the future health of the mother. Hence, pregnancy is like a stress test to check whether you are likely to develop diabetes in the future. In the majority of women (about 90%) the diabetes state resolves when the offending placenta is delivered at birth. However, more recent data confirms that 1 in 10 women with gestational diabetes remained diabetic at the standard 2 month post-partum check. This is a very disturbing trend. In 2005, we found that women with previous GDM who had reverted to normal at immediate postpartum, when checked at 3 years after childbirth- were found to have the metabolic syndrome afflicting as much as 50% of them, at a mean age of 33 years. More recently, women with GDM recalled after 1 year postpartum were found to have a substantially higher prevalence of diabetes/pre-diabetes.

### **What is the impact of gestational diabetes on the new born?**

The massive hormonal changes of pregnancy occur due to the growing placenta producing hormones. Additionally, the pregnant woman prioritizes her body energy to be converted into glucose to nourish her growing baby at all times. Maternal insulin resistance rises in an exponential manner. If the pregnant woman has a pre-existing insulin resistance and thereby an exhausted pancreas with potential to develop insulin deficiency early in life, she develops high blood sugar and requires insulin for correction. If unnoticed and uncorrected, the high blood sugar leads to excess fat laden in the baby's body and cause many complications including sudden fetal death due to fluctuating blood sugar and salts. The mother is also at high risk of developing the dangerous high blood pressure of pregnancy (pre-eclampsia), caused by disease of her placental blood vessels. These can prove life threatening. Such unhealthy placentae can cause poor fetal growth and underweight babies. When the newborn's supply of excess blood sugar from the mother is cut off with the clamping of the umbilical cord, the excess insulin from the baby's pancreas that occurred while in the womb causes a paradoxical low blood sugar and places the newborn at risk of brain damage. Additionally, mechanical and biochemical problems at birth lead to many problems for the newborn. In the long-term these babies (born big or small) have a greater risk of excess fat accumulation in their bodies from early life. Such offspring are at even greater risk of diabetes than their mothers.

### **Hence, diabetes begets diabetes.**

Diabetes often has no symptoms. Although Diabetes Mellitus ranks among the leading causes for morbidity and mortality in South Asia, the majority of those affected remain unaware they have the disease. A recent Lankan survey of 25,000 households to study adults by self-reporting their diseases found high blood pressure afflicts one-third and diabetes one fifth. The vast majority who reported they have no disease had not checked themselves. This is exactly the problem. Unless one checks oneself regularly you never know you have severe disease. Women with previous GDM should check themselves annually.

Diabetes is an environmental disease. It starts in the mother's womb. Hence, the very reason to concentrate on making pregnancy healthy and thereby ensure a healthy future generation.

The most important aspect to control of blood sugar, blood pressure and cholesterol is healthy lifestyle and regular monitoring of blood sugar. No doubt many drugs, particularly metformin, are required lifelong. But the responsibility falls on the patient – through self-regulation and self-monitoring.

The patient and family is in the driving seat not the doctor. Besides being a debilitating disease, diabetes is also a costly disease to treat. Prevention is cheap and is far better than taking a medical insurance. Healthy diet and lifestyle with no smoking and alcohol will ensure good health – provided this is adopted from early life.

Our greatest concern is the long months and years of poor quality of life that patients suffer in their productive years from the complications of diabetes. This is called Disability Adjusted Life years (DALYs)- and this is extraordinarily high for diabetes with annual increase of over 3% in Sri Lanka.

Obesity – particularly central obesity is a major reason for diabetes and PCOS among women. The main reason is starch laden, fat laden, sugar laden unhealthy food with inactive lifestyle. A growing number of South Asian children have also been found to be pre-diabetic.

### **What is the likely reason?**

In fact, the rubber stamping occurs in the mother's womb and thereafter the environment encourages unhealthy lifestyle and excess body fat.

Our society needs to address that a fat child is not a healthy child and avoid this situation at all costs. The most effective preventive process that must be adopted is health promotion – and that is the way forward.

No doubt the girl child with excess body fat is at risk of her hormones getting into a state of great imbalance. Puberty is a stage in life when one is at greater risk of insulin resistance. Hence the hormonal imbalance causes irregular periods and the insulin resistance causes darkening of skin folds – *acanthosis nigricans*. Mothers often think this is a dermatological condition. It is only a reminder that snacks, biscuits and sweet drinks given to your daughter must be stopped!

A few genes when interacting with unhealthy environment cause an increased risk of diabetes. We cannot blame our genes and just wait inactively. There are a few situations (<3%) where early onset adult type diabetes is due to a single gene defect that tends to run in families. Some of these are easily managed by lifelong medication.

Whereas unhealthy lifestyles like eating too much sugar and oily starchy carbohydrates are bad practices that collectively place young adults and children at higher risk of diabetes. Starch, sugar, unhealthy oils and salt - are all evident in the emerging markets of fast foods and processed foods in South Asia. Sugar sweetened drinks are blamed for the South Asian diabetic epidemic. Many fruit and milk drinks are available freely in the open market. Despite advertisement banning being endorsed, unhealthy drinks are sold at school sports meets and sports tournaments with enticing labels claiming they can enhance performance and intelligence.

The South Asian societies need to develop a good civic sense among the advertisers, food producers and consumers- particularly in schools. We need to lobby and advocate to encourage a healthier future generation. The Nirogi Maatha project of the Sri Lanka Medical Association advocated since 2012 and saw to fruition a government commitment for Universal Screening of pregnant women using blood sugar. This was a major step forward. The mother's card has included in it since 2007 the blood sugar value and BMI of the mother at booking – that is in over 95% within the first trimester (first 3 months). Sri Lanka has all the essential ingredients

to overcome this problem by proper system management and public cooperation and commitment.

All pregnant women are being screened for diabetes on a routine basis and if any of them are found to have diabetes, are managed in the hospital to control their diabetes before delivery. Nirogi Maatha also introduced the concept of such mother-baby pairs be reviewed long term. This can prove challenging- as women once they have had their baby tend to slip back into an unhealthy lifestyle and avoid coming back to get themselves checked.

We need to overcome such drawbacks by supporting women's groups through media, schools and colleges, workplaces and in community settings.

We also need to ensure that such women with GDM and/or PCOS are not marginalized, and emphasize prevention through body weight control before and after pregnancy. Here again the food and milk industry play a negative role through unhealthy advertisements. Health lifestyle must be adopted throughout the lifecycle in citizens of the whole of South Asia. Parents, the public and women in particular can play a major role in preventing diabetes. South Asians health is in their hands.

The International Diabetes Federation (IDF) in 2005 introduced abdominal obesity (rather than insulin resistance) as a prerequisite for the diagnosis of pre-diabetes or the Metabolic Syndrome (MetS) which is a collection of risk factors for developing diabetes and cardiovascular disease, with particular emphasis on waist measurement (WC) as a simple screening tool.

Lifestyle modification (LSM) is recommended as the primary intervention for MetS. Interventions with LSM have achieved weight loss and improved quality of life by a health promotion model within a short period of 3 months. These recommendations are supported by physiological studies, clinical experience, observational studies, and randomized controlled trials. Although the long-term effects of intensive lifestyle intervention outcomes of MetS with corrections for the effects of genetic propensity, ageing, gender, polycystic ovary syndrome and the development of diabetes are awaited, the overall benefit of LSM is not debated.

In conclusion, a healthy lifestyle is critical to prevent or delay the onset of the Metabolic Syndrome, GDM and type 2 diabetes in susceptible individuals and to prevent cardiovascular disease and type 2 diabetes in those with existing MetS. A population wide approach is no doubt cost effective.

A singular focus on fetal health and nutrition in the 21<sup>st</sup> century through diabetes risk reduction among women through their lifecycle can be the mainstay of primordial prevention of diabetes in the South Asian region.

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***Symposium 1: Stimulants, Addictions and Behavioural Change in Nutrition***

**Plenary Lecture**

**The Power of Tiny Habits: Behavioural Change in Health & Nutrition**



***Dr. I. Harshani Rajapakse,***

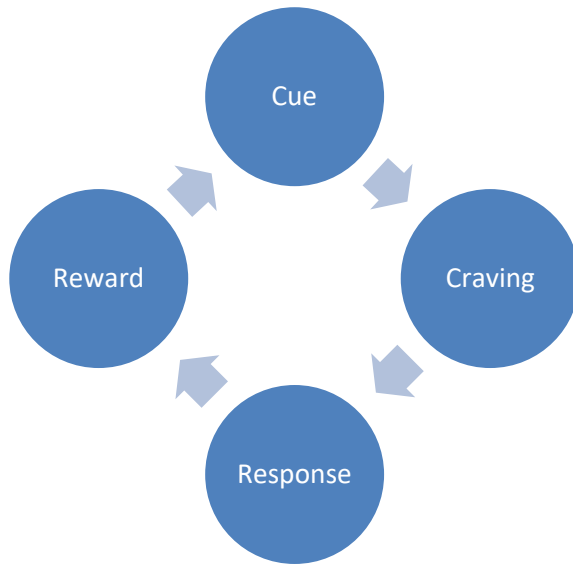
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One of our tasks as doctors is to help the patients to sort through their health and nutrition. The key to any long-term success - whether that is around nutrition, exercise, or getting rid of bad habits, is building slowly over time and continued moderation. Progress is what we need to focus on, not the perfection. We can apply this with our patients and even apply it to our behaviours.

Changing behaviours are always challenging, but with the right awareness and support, we can craft the behaviours to help our patients and us, to achieve goals and become whom we would like to be. When we think about the habits most of us have, many are well-established. Every day we make choices that we do not have to consider or think about. We simply do them and the same is true of our patients.

We look to diets and exercise to heal our food and body weight problems. Those interventions will never be fully effective if we do not make it a habit. For this we need to change our thinking and behaviours.

What are the things we know we could be doing differently for our health and wellbeing? Knowing about “Habit cycle” is useful for putting positive habits in action and break old habits.



Mr A used to come home very tired. He keep his bag aside and sleeps in his chair. He gets up with a backache and neck pain. Also he is hungry and goes to the kitchen and eats a salty snack while browsing his facebook page. Then he feels good. He has hypertension and his doctor has advised him not to take food with added salt and exercise regularly. When he tries to take big commands like “Stop this! Do that!” he become mentally and physically exhausted.

It is not just about the snacks or internet addiction. We need to pair a new behavior with something you already do. When I do A, then I do B. Or in this case, “As soon as I come home, then I will take a bath or have a cup of green tea. We should think about how we can tie the new behavior to something we already do. It can be that simple.

The craving then can be the feeling of freshness after a bath or drinking a cup of green tea before anything else. That feeling of freshness or warmth is the first thing we think of. The sense of how that feels in our body when we do it is the reward we get.

The next hurdle is how to stop the urge. ‘Urge Surfing’, on average, takes about 15-20 minutes before cravings goes away. Depending on the habit, this could differ, but the key is to remember any craving will eventually go away. The first time we try to resist the urge and surf the wave, it’ll feel pretty intense and difficult. The brain is used to giving in to the bad habit, but eventually with repeated practice and saying “no”, it gets easier.

The methods suitable for Mr. A, who goes straight in to the kitchen and eat unhealthy snacks can be named as the 4 Ds.

1. Distracting - to do something else (go for a walk, listen to music)
2. Distancing - to keep in a place not easily accessible or not to keep salty snacks at home
3. Displacing - keep some fruits or unsalted nuts
4. Discussing - to tell a friend, family, about your plan or achievement.

We should encourage the patients to change the behaviours starting from one small step. When that is achieved they get positively reinforced and that will have a cascade reaction. The more

positive habits we can introduce, we can help our patients to improve their health and nutrition. We need to provide positive regard and appreciate, when the patients achieve the goals. When we create a new habit we can celebrate our personal victory by sharing it with a loved one, buying a gift for yourself or simply whispering “I am awesome”. If and when we fall back in to an old bad habit it is important not to feel guilty or discouraged but to discuss why it happened and try to correct the reasons. No one is perfect and progress in tiny steps is what leads to success in health and success in life.



## *Symposium Lecture*

### **Dietary Supplements, Stimulants and Doping**



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The history of doping is as long as the games its self. In 700 BC the ancient Greek Olympic Games, athletes were encouraged to consume sheep testicles, which contain testosterone, as a means of boosting strength. The next significant event was in

1904 when marathon-runner Thomas Hicks receives two injections containing the stimulant strychnine (plus some brandy) from his trainer during the race itself. Although extremely dangerous, he goes on to take home the gold.

In 1928 The International Association of Athletics Federations (IAAF) became the first sporting body to ban the use of doping agents for enhancing performance. The IAAF, however, was limited in its ability to enforce the new ruling. Instead it relied mostly on an honesty policy from athletes.

In 1954 a physician for the US weightlifting team learnt that the Soviet Union team had been using testosterone to boost performance. The US team begins to use anabolic steroids soon after. In 1960 Danish cyclist Knud Enemark Jensen dies during the Rome Olympic Games after taking amphetamine – a stimulant – and Roniacol, a blood vessel dilator.

In 1964 Anabolic steroid use becomes ubiquitous at the Olympic Games and in other sports, including bodybuilding.

Subsequently in 1966 Drug testing begins for the first time at the European Athletics Championships, held in Budapest, Hungary. In 1976 the first test to reliably detect anabolic steroids was developed, enabling governing bodies to ban these substances in future Olympic Games. Then in 1988 100m sprint Olympic champion Ben Johnson is stripped of his gold medal for doping. Soon after on the 10<sup>th</sup> of November 1999 WADA was established.

Then in 2009 the Athlete Biological Passport program was launched. An athlete's biological marker information can now be tracked over time, allowing investigators to spot the introduction of doping agents. In 2012 Seven-time Tour de France-winning cyclist Lance Armstrong was stripped of all titles received since 1998 after drug and blood doping.

In September 2013 SLADA was established by an act of parliament. 2015 Russian athletes were banned from international competitions after evidence emerges of state-sponsored doping cover-ups.

2020 COVID 19 hits all sports. The WADA prohibited list is an important document which can be summarized as follows;

**Prohibited substances (at all times)**

- Non approved substances (S0)
- Anabolic steroids (S1)
- Peptide hormones, growth factors mimetics (S2)
- Beta 2 agonist (S3)
- Hormones and metabolic modulators (S4)
- Diuretics and masking agents (S5)

**Prohibited methods**

- Manipulation of blood and blood products (M1)
- Chemical and Physical manipulation (M2)
- Gene and cell doping (M3)

**Prohibited substances (in competition)**

- Stimulants (S6)
- Narcotics (S7)
- Cannabinoids (S8)
- Glucocorticoids(S9)

**Prohibited in particular sports**

- Beta blockers (P1)

A dietary supplement is a manufactured product intended to supplement one's diet by taking a pill, capsule, tablet, powder or liquid. It is a 37 billion dollar industry, 50% of US population is taking supplements and 90% of Sri Lankan athletes use supplements. Supplement could be divided in the following categories

- Vitamins
- Minerals
- Essential fatty acids
- Protein and amino acids
- Body building
- Natural products
- Probiotics

Whey protein is excellent source of protein it is easily absorbed, one scoop can have up 30 g of protein Contains lactose and can cause allergies. Creatine leads to enhanced maximum isometric strength ([Maganaris& Maughan, 1998](#)) and the acute performance of single and repeated bouts of high-intensity exercise (<150 s duration). Creatine requires.

A loading dose of 20 g/day (divided into 4 equal daily doses), for 5–7 days ([Lanthers et al., 2017](#)). A maintenance-phase: 3–5 g/day (single dose) for the duration of the supplementation period ([Hultman et al., 1996](#)).and finally a wash out period of 4 weeks.

Methyl hexamine (DMAA)is a sympathomimetic which as caused many deaths and is banned by US military and many other countries. However, it is freely available in Sri Lanka!

Anabolic supplements contain anabolic steroids or their derivatives. They are used extensively

by body builders and are again freely available. However, they have many side effects.

Other supplements that have been proven to be effective are: Caffeine 3–6 mg/kg of BM, in the form of anhydrous caffeine (i.e., pill or powder form), consumed ~60 min prior to exercise (Ganio et al., 2009). Lower caffeine doses (<3 mg/kg BM, ~200 mg), provided both before and during exercise; consumed with a CHO source (Spriet, 2014) also improve performance.

Dietary nitrate (NO<sub>3</sub><sup>-</sup>) Acute performance benefits are generally seen within 2–3 hr following a NO<sub>3</sub><sup>-</sup> bolus of 5–9 mmol (310–560 mg) (Hoon et al., 2014). Prolonged periods of NO<sub>3</sub><sup>-</sup> intake (>3 days) also appears beneficial to performance (Thompson et al., 2015, 2016) Beta alanine Daily consumption of ~65 mg/kg BM, ingested via a split-dose regimen (i.e., 0.8–1.6 g every 3–4 hr) over an extended supplement time frame of 10–12 weeks (Saunders et al., 2016).

Sodium bicarbonate. Single acute NaHCO<sub>3</sub> dose of 0.2–0.4 g/kg BM, consumed 60–150 min prior to exercise (Carr et al., 2011b; Siegler et al., 2012) What is the situation in Sri Lanka? We conducted two studies to look at supplement use. The first one was a study titled “Dietary supplement usage of athletes in a South Asian regional country; Sri Lanka”. We analyzed the use of supplements in 14 sports. We found a very high percentage of athletes used dietary supplements (90%) of them, mainly multivitamins (62.5%), protein (47.4%), creatine (19.0%), rehydration fluids (54.5%) weight gainers (1.1%) the lowest. Players in all 14 sports showed more than 75% dietary supplement usage while badminton, shooting, wrestling, netball and rugby showed significantly higher usage than karate which had the lowest usage. Supplement usage pattern was showed a geographical variation where as six provinces showed more than 90% usage compared to the others. A significant increase in supplement usage was observed in athletes between 21-35 ages. No significant difference was observed in the supplement usage pattern respect to marital status, gender, occupation of the athletes or the level of participation. All the participants took a carbohydrate rich diet for lunch and 13% cereal for breakfast and 4.2% vegetable and meat rich diet for both breakfast and dinner. Among them 10.9% consumed junk food for dinner. From these players 81.9% used fruits, 54.9% used porridge, 43% used soup and 22.8% used drinks made from medicinal plants show similar tendency in using dietary supplements (more than 90%). Among vegetarians (3.6%) the supplement usage was 85.7% which includes 57.1% protein supplements. While dietary supplement usage is high among Sri Lankan athletes irrespective of sport, dietary habits and social status, their dietary practice needs to change.

The second study was titled “The health effects of the combined use of protein, multivitamins and electrolytes and dietary supplements on Sri Lankan athletes; a pilot study”. This was A Retrospective Cohort, pilot study was conducted with 45 healthy athletes (23 males and 22 females), age between 22-31. This study showed that the combined use of multiple supplements (MS) between 2-5 months, had a negative effect on the lipid profile of athletes. It was more pronounced in females. However, the clinical implication of this finding needs further study. I conclusion supplement usage is rampant in Sri Lanka and urgent action is needed to restore control of the situation.

## *Symposium Lecture*

### **Role of Public Sector in the Prevention of Addictions**



#### ***Dr. Laknath Welagedara***

*Consultant Physician, Teaching Hospital Colombo, South, Chairman, National Dangerous Drugs Control Board*

Being thankful for this opportunity, I extend my deepest gratitude to The Nutrition Society of Sri Lanka for inviting me for the Annual Scientific Sessions - 2021 for a speech on this timely important theme 'Stimulants, Addictions & Behavioural Change in Nutrition'.

#### **Extent of the Drug Problem**

As we all know, substance abuse has become more abundant everywhere, more sophisticated and more diverse than it has ever been before. The extent of the drug problem and emerging threats with their devastating adverse consequences, affect severely on health and welfare of people with overdose deaths, permanent physical and psychological damage including agitation, violent behaviour, psychosis, paranoia and anxiety, fatal and non-fatal intoxications. This emerging problem impacts adversely on the right of people to lead a healthy life and to live in a safe society. Also affects severely on the children and adults across the world, affects socio-economic development, security, stability and sovereignty of the countries.

The illicit drug markets are continuously changing; new synthetic drugs are emerging at an unprecedented rate. The rapid emergence of a large number of substances in the form of various products or preparations such as drug laced products and as **food/nutritional supplements** is common. With these emerging threats, the drug problem poses a significant risk to public health as these products are not regulated and not detected by law enforcement agencies and by health authorities in standard toxicology screens. Therefore, exposure to these drugs/substances and preparations in cases medical treatment may remain unrecognized and under-reported.

#### **Substances abuse and Nutrition**

On consideration of the nutrition perspectives, substance abuse leads to lifestyle changes which include irregular eating and poor diet. Proper nutrition is a vital part of the healing process in addiction recovery in order to improve and maintain healthy organs and to cope infection. Therefore, it is highlighted that implementing proper nutrition guideline will help drug dependent persons recovering from addiction heal faster and more effectively in the detoxification period and to recover from the damages caused to the systems and the body organs.

People suffering from addiction typically experience constipation and withdrawal symptoms such as diarrhea, nausea, and vomiting which eliminates its nutrients and result in nutrient deficiency and imbalance of electrolytes. Accordingly, substance abuse is one of the leading causes of nutritional deficiency. It has been reported that the people suffering from substances abuse typically suffer from vitamin B6, thiamine, and folic acid deficiencies, which cause anemia and neurological problems. Substance abuse affects the liver and the pancreas and such damages causes an imbalance of fluids, calories, and improper toxin removal. Complications include diabetes, high blood pressure, permanent liver damage, seizures, severe malnutrition, and a decreased life expectancy. Stimulant type of drugs such as cocaine, amphetamine, methamphetamines and ketamine reduce appetite and can cause severe weight loss and poor nutrition. Stimulants addiction also causes dehydration and loss of key electrolytes. Drug users may also cause memory problems, which become permanent as a result of prolonged use of drugs.

On the other hand, proper nutrition responsible for producing and maintaining serotonin levels and other neurotransmitters, providing a barrier against toxins, limiting inflammation, and helping to absorb nutrients from food and bodily functions not only affect physical health and nutrient absorption, it also affects mood and determine how individuals feel and respond to situations.

Considering all above it is essential that properly balanced nutrition to improve individual's emotional health and physical health, elevate mood and prevent depression.

#### **How Can Nutrition Affect Addiction Recovery?**

Because of the strong influence of nutrition on mood and physical health, it is vitally important to incorporate a healthy diet within an addiction recovery program to promote long-lasting healing. However, it may be difficult for the person suffering from addiction to stop taking drugs and adopt a strict diet. Therefore, it is essential that eliminating of drug use while only implementing simple, step-by-step dietary changes to regular mealtimes, adding in more protein, complex carbohydrates, and fiber, and starting some vitamin and mineral supplements to aid in recovery while improving nutrition.

On consideration of the relapsing nature of the drug addiction, it is more likely that the drug use individuals to relapse when the person has poor eating habits. Therefore, introducing regular meals with proper diet is very important. Drinking plenty of water is also an important part of nutrition in addiction recovery on consideration of the processes of the elimination where dehydration is common during the recovery process. Considering all above it is important for the person in recovery to eat healthy, nutritious meals and to avoid nutritionally-void foods like sweets and processed foods.

#### **Importance of Nutrition for drug addiction recovery**

Drug addiction recovery is a long healing process which includes many components. One of the first stages of addiction recovery is detoxification which involves removals of drugs out of the person's system and allowing them to go through withdrawal side effects while under medical supervision. During this period medical professionals individuals' overall health and nutritional intake is being monitored to help them become stronger and better able to handle addiction recovery.

The next step involves rehabilitation with a number of therapies, such as Cognitive Behavioural Treatment (Relaxation, Imagination Techniques, Role play, Exercises), Behavioral Treatment, Rational Emotional Therapy, Psychoanalysis, Trauma inform of care (Trauma Counseling),

Relaxation techniques, Soft Skills Development, Sports Therapy, Therapies of re-examine the past experience, Reversal Therapy, Life skills development therapy, Motivational Therapy, Affect Therapy, Self Esteem Building Therapy, Self Confidence Building Therapy, Art Therapy, Crisis Intervention/ Management, N.L.P Therapy, Drama Therapy, Mindfulness cognitive therapy which must include nutritional counseling.

Someone in addiction recovery may see a nutritionist for help with improving nutrition and health through custom dietary regimens and healthy supplements.

Nutrition and nutrition counseling are vital parts of developing good overall health and helping the body to recover from the effects of addiction to keep balance emotions and repair cerebral functions and processes. Combined with other physical and behavioral therapies, nutrition has the power to literally change structure and functions in order to address the way you feel about and react to drug use.

When nutrition is combined with behavioral therapies and individual, group, and peer supports, those suffering from addiction have the best chances at recovering and maintaining abstinence from drug use. Therefore, it is essential that the people addicted to drugs need support from nutritionists for overcoming the problem which is vital in achieving successful, long-lasting addiction recovery.

### **Role of Public Sector in Preventing Addiction**

#### **Awareness of the extent of the Problem**

It is vital that the Government sector agencies recognize the extent of the drug problem and adverse consequences with respect to physical and emotional damage, drug associated illnesses, transmission of HIV, the hepatitis C virus and other blood-borne diseases associated with drug use, upsurge in drug related crime; effect on socio economic development of the country, effects on the security and stability of the country, the draining of human, natural and financial resources and the destruction of individuals, families and communities.

Further, as members of the government sector we all must be well aware of the complexity of the of the problem and emerging challenges such as emergence of range of drugs, risks associated with synthetic drugs and new psychoactive substances which have reached alarming levels, expansion and diversification of drugs markets where abuse, illicit cultivation and trafficking of narcotic drugs and psychotropic substances and precursors have reached record levels, rise of the demand for illicit drugs and the increase of domestic diversion of pharmaceutical drugs; increasing links between drug trafficking, corruption and other forms of organized crime, including trafficking in persons such as women and children, unitization of modern scientific methodologies, equipment and scientific advancements and communication tools such as internet and postal services for drug trafficking activities and promoting drug abuse, cybercrime and money-laundering, increasing risk posed by synthetic opioids and the non-medical use of prescription drugs and as well as scientific, legal and regulatory challenges in combatting drug trafficking and abuse.

#### **Government policy frame work of “Vistas of Prosperity and Splendour”**

The government reaffirms its political will and the commitment in the Government policy frame work of “Vistas of Prosperity and Splendour” aimed at achieving the fourfold outcome of a productive citizenry, a contented family, a disciplined and just society and a prosperous nation.

Of ten key policies identified in the policy frame work of “Vistas of Prosperity and Splendour”, in the first key policy “Priority to National Security”, it has been recognized the

establishment of a country free from drug abuse as a national priority in order to ensure a safe and a secure country for all.

### **Need for a Coordinated Strategy**

It has to be recognized by all related agencies that the persistent, new and evolving challenges with respect to drug problem should only be addressed with the establishment of mechanisms with integrated, multidisciplinary, mutually reinforcing, balanced, coordinated, scientific evidence-based strategies with shared responsibility.

All ministries, departments, institutions, authorities, provincial councils, provincial ministries,

provincial departments, district secretariats, divisional secretariats, Grama Niladaris and all other institutions that come under government purview, civil societies, scientific community and academia, non-government organizations, private sector agencies and as well as all citizens should be active partners in designing and implementation of effective drug prevention and control mechanism with strong partnerships.

### **Effective approach to Combatting drug trafficking and abuse**

The two main approaches to effectively combat drug trafficking and abuse problem in Sri Lanka National Drug Policy for prevention and control of drug abuse are drug supply control and demand reduction.

It emphasized that the most effective approach to the drug problem would comprise of a Comprehensive, balanced, and coordinated and scientific evidence based strategy with increased national and international cooperation with high sense of shared responsibility where supply control and demand reduction will reinforce each other.

The four main pillars which has been identified as key policies in addressing the drug problem are as follows;

1. Drug demand reduction
2. Drug supply Control
3. Co-ordination and co-operation
4. Information management, research, monitoring and evaluation

### **Demand reduction**

Demand reduction, consists of prevention Treatment, rehabilitation and aftercare

### **Prevention of Drug Abuse**

Drug use prevention activities are aimed at stopping drug use before it starts, discouraging initial drug use from progressing into problem drug use, and ending addiction and its associated damaging health and crime consequences. In preventing drug abuse, it is emphasized strategies under three main areas: the age of the target group, the level of risk of the target group and with the delivery setting which consists of evidence-based interventions in order to support children and youth throughout their development and particularly at critical transition periods where they are most vulnerable, e.g. infancy and early childhood, at the transition between childhood and adolescence, drug prevention programmes for target population such as selected support groups and individuals particularly at risk addressing both individual and environmental factors of vulnerability.

Furthermore prevention activities are targeted to reach multiple settings such as families, schools, communities, the workplace, etc. Programmes and activities for strong infrastructure for the delivery of drug prevention programmes, activities to address the media promotion and

to ensure sustainability of programmes implemented are also incorporated in the National Action Plan for Combatting illicit drug trafficking and abuse, while addressing the use of alcohol and tobacco as gateways to illicit drug abuse.

### **Treatment, rehabilitation and aftercare services**

Based on initial assessment on the level of dependence associated behaviors, treatment, rehabilitation and aftercare programme are designed to help drug use individuals to find their ways out of drugs which consists of several phases such as withdrawal period which involves detoxification programmes in hospital settings under supervision of a psychiatrist, convalescence period with physical symptoms of irritability and restlessness within which their physical and mental conditions reaches normal level with the introduction of psychotherapies by counselors/psychologists. They are introduced coping skills and cognitive strategies to prevent replace and dysfunctional behaviours and cognitions which supports abstinence from drug use. Thereafter within rehabilitation period, after recovery assessment they are given vocational assignment to develop skills to occupy him in useful works. In the process of social re-integration, aftercare services needed by the recovered individuals to meet problems in the new setup and follow up activities are provided by the Government Officers established within the community and Divisional Secretariats.

Moreover, screening and scientific evidence based practices are promoted for effective and efficient treatment and rehabilitation programme and effective interventions and medical treatment overdose, cooccurring and mental disorders. These approaches aimed at treating HIV, Hepatitis C and B and sexually –transmitted diseases (STD's) and other adverse health consequences of engaging “hard core users” are addressed with the health system and social services, and curbing public disorders and criminal behavior related to drug use.

### **Supply Control**

Drug supply Control involves the efforts to curb access to illicit drugs and the primary objective of supply control strategy is to eliminate the availability of illicit drugs. Supply control activities are designed to improve the national capacity to reduce the production, distribution and availability of illicit drugs, substances, articles and their preparations for abuse and preventing the diversion of medicines of high abuse potential and diversions of chemical products used in the manufacture of illicit drugs.

Supply control activities include monitoring situations, appropriate investigative and interdiction activities, effective law enforcement activities, capacity building for skills and knowledge enhancement to effectively and safely execute responsibilities, provision of technical resources and cooperative mechanisms against maritime drug trafficking and drug trafficking through coastal boarder, sea ports and airports and in the fisheries sector, internet drug trafficking and using postal services, including actions against cultivation, and production of illicit drugs within national borders, legislative measures to address the emerging trends, rapid spread of new psychoactive substances non-schedule substances, judicial cooperation, strengthened legal and institutional frameworks for elimination of drug supply, suppression of drug related organized crimes including money-laundering, illicit financial flows, corruption, trafficking in persons, trafficking in firearms, cybercrime and drug related corruption.

### **Role of Public Sector Agencies related to Nutrition and Dietetics**

Within the programme of drug prevention and control nutritionist and dietitian play a critical role in supporting nutrition intervention in treatment and rehabilitation programme.



Therefore, it is highly essential to establish a mechanism to coordinate with professionals in the field on Nutrition and Dietetics in order to identify nutrient deficiencies and implement appropriate interventions through nutrition assessment, including a nutrition-focused physical exam. In this way, nutritionists and dietitians can help optimize patients' cognitive and emotional functioning so they can benefit more from treatment.

Prescription of a therapeutic diet as appropriate and education of the drug use individuals on the purpose of the diet, how to follow it, and address any barriers that may prevent him or her from following it, are essential components in the treatment and rehabilitation programme. Furthermore, there is a huge responsibility on dietitians to in the drug abuse preventive education and treatment and rehabilitation program to educate addiction treatment professionals and drug use individuals on healthy lifestyle practices, such as maintaining a healthy weight, exercising regularly, and getting enough sleep as an essential component in treatment programme.

Dietitians can also assist in creating healthy menus that reduce costs and food waste, provide in the residential treatment programs for the facility, and implement data-driven quality assurance performance improvement programs to ensure quality food- and nutrition-related services are provided to patients. Further, it is also highlighted that Nutritionists and Detritions take aggressive actions to engage in conducting research in the field of addiction recovery and nutrition care is integrated in the protocol having good collaboration with the National Dangerous Drugs Control Board (NDDCB).

Moreover, use of dietary supplements among the general population has gained popularity in recent years which may be due to various factors such as over-the-counter availability of dietary supplements, and perceptions that dietary supplements are safe to use.

Although some dietary supplements may have acceptable safety profiles, many are associated with adverse events and have proven presence of narcotic drugs, psychotropic substances, other newly emerging drugs including prohibited substances in Sports. Despite the potential harm associated with use, the use of dietary supplements among the adolescent population has been reported. Furthermore, the harmful effects of dietary supplements may be enhanced if the agents are abused or misused. Therefore NDDCB has proposed to take regulatory measures to supplements ensuring the quality of the products and absence of harmful narcotic drugs, psychotropic substances, other newly emerging drugs including prohibited substances in Sports prior to release in to the Market.

The NDDCB, being the principal national institution for prevention and control drug abuse in Sri Lanka and as the national focal point has recognized that the drug problem can only be effectively addressed through a comprehensive, coordinated strategy and multilateral setting where supply control and demand reduction strategies are implemented.

We have recognized the importance of the strong collaboration among all sectors which are crucial to enhance drug prevention and control activities and accelerating the progress in achieving the ultimate goal of the government to establish a country free from drug abuse. Considering all above role of professionals in the field of nutrition play a significant role to improve treatment outcomes and restoring the nutritional status of drug use individuals, prescribing therapeutic diets to manage health conditions brought on by alcohol or drugs, and by providing nutrition education and promoting an overall healthy lifestyle.

In this important occasion, I'm delighted to invite the Nutrition Society of Sri Lanka, its members and all participants to take hand with National Dangerous Drugs Control Board to collaborate towards achieving our ultimate goal a secure country free from Drug Abuse. I thank you again for inviting me to this important event and thank you for your kind attention.

## ***Symposium 2: Role of Development Sector in Nutritional Wellbeing***

### ***Plenary Lecture***

#### **Shared Vision in Policy Making for a Better Nutrition**



***Dr. Lakmini Nayana Magodaratne***

*Consultant Community Physician, Acting Director, Nutrition Division, Ministry of Health, Sri Lanka*

Nutrition, as a maker and marker of development, is a foundation to the Sustainable Development Goals. The aims of SDG2 and SDG3 directly address nutrition which aims to end hunger, achieve food security, improve nutrition, address all forms of malnutrition for all age groups, and ensure health and well-being for all at every stage of life.

Availability, accessibility, affordability and utilization of nutritious food or in other words food and nutrition security are essential to improve nutrition. We are well aware that hunger and poverty are key constraints of food insecurity which are more exacerbated by rising prices of food. The current COVID 19 pandemic situation may worsen this situation calling for urgent intervening from all responsible parties.

Why I said “from all responsible parties” is optimal nutrition status for every citizen in any country is only achieved through multi-sectoral actions that are not limited to health systems alone, though Ministry of Health is responsible for the stewardship, advocacy and regulatory functions etc.

Achieving and sustaining optimal nutrition status for every citizen depends on the contributions of multiple and interconnected actors. Focusing on strengthening the capacity of a single stake holder or strengthening a single collaboration is insufficient. Achieving optimal nutrition status for every citizen should be a shared policy priority and should include in the respective policies in all relevant stakeholders who are identified being responsible for nutrition sensitive interventions.

Unfortunately nutrition-related services are often delivered in sectors specific silos despite the broad agreement that nutrition is a multi-sectoral problem. We have to share the vision for good nutrition, growth, and development through engaging and enabling a wider range of service providers to include it in their respective policies. Program designers, planners, and implementers must work together with a range of stakeholders to create a shared policy platform and a harmonized approach to identify strategies and activities to implement including who and how to do so.

I would like to give few inputs for selected stakeholders that could be shared in their policies to achieve sustainable optimal nutrition status for every citizen in Sri Lanka.

**Ministry of Agriculture should include nutrition sensitive policies to**

- promote the production of nutrient-dense foods and nutrient-rich crop production techniques (e.g., bio-fortified crops, use of mineral fertilization).
- promote Good Agricultural Practices (GAP), including time-saving, energy-saving, and women friendly inputs, technologies, and techniques for production, harvesting, processing, and storage; for the prevention of contamination; and to minimize exposure to agrochemicals.
- promote better use and conservation of soil and water.
- promote linkages between farmers and markets to increase availability and affordability of nutrient-dense foods, obtain the best sale price, and ensure the cold chain, as needed.
- establish, maintain, and promote a system for tracking food production, prices, and early warning signs of drought and famine.
- collect, analyze, share, and use information on consumption, production, weather, and prices of inputs, supplies, and produce.

**Ministry of Health should include nutrition sensitive policies to**

- promote skills needed to make and act on the most appropriate and positive decisions related to the use of health services.
- advocate for increased access to and availability of health services, particularly for women and young children.
- provide quality health services for all people of all ages that includes
  - screening for malnutrition (e.g., height/length, weight, mid-upper arm circumference, anemia)
  - treatment or referral for malnutrition
  - counseling, support and demonstration (as appropriate) of optimal caring practices, particularly for adolescent girls, pregnant and lactating women, and children.
- promote the use of health services.
- identify and address barriers to women and adolescents accessing health services.
- collect, analyze, share and use information on health and nutritional status.
- promote skills needed to make and act on the most appropriate and positive decisions regarding caring practices.
- identify and address gender barriers to adopting and sustaining optimal caring practices.
- develop, implement, or enforce nutrition-friendly policies for the community, schools, health facilities, and/or workplaces.
  
- promote and/or model optimal caring practices, such as
  - optimal age-appropriate dietary practices and eating patterns
  - consumption of appropriate supplements and/or fortified foods

- use of insecticide-treated bed nets and deworming medication
- WASH practices
- delayed marriage and pregnancy
- optimal birth spacing.
- 

**Ministry of Environment should include nutrition sensitive policies to**

- promote skills needed to make and act on the most appropriate and positive decisions to ensure a clean environment.
- develop, implement, and enforce WASH-friendly policies for the community, schools, health facilities, and/or workplaces
- advocate for WASH facilities (e.g., toilets/latrines, hand washing stations, water storage, cooking stations) in homes, schools, health facilities, workplaces, and market places
- provide or maintain WASH facilities (e.g., toilets/latrines, hand washing stations, water storage, cooking stations) in homes, schools, health facilities, workplaces, and marketplaces.
- promote WASH practices, including the use of WASH facilities and products (e.g., water treatment and storage, soap).
- promote the use of moderate quantities of pesticides and fertilizers (both organic and inorganic) within safe distances from drinking water sources.
- collect, analyze, share and use information on water, sanitation and the environment.

**Ministry of Finance should include nutrition sensitive policies to**

- promote skills needed (e.g., budgeting and budget tracking) to make and act on the most appropriate and positive decisions regarding how income is saved and used for food, caring practices, health, a clean environment, and education.
- provide low-cost loans, particularly to women.
- identify and address gender barriers to household resources/income.
- promote income-generating activities.
- promote market access to help producers, processors, and retailers to sell their products and generate income that can be invested in better health, care, and food consumption.
- administer conditional cash transfers and other social support programs, targeting households that are nutritionally vulnerable (households with malnourished children or age-based targeting).

**Ministry of Women and Child Affairs should include nutrition sensitive policies to**

- develop and adhere to a "gender-friendly" policy that prioritizes women's empowerment and men's engagement in nutrition, growth, and development, identify and address gender barriers.
- take steps to keep adolescent girls and women in school (formal or non-formal education).
- advocate for women's control of resources and role in decision-making.
- build women's confidence to make decisions and manage household resources.
- promote technologies that can save women's time and energy.
- target women in income-generation interventions, including but not limited to agriculture and livestock rearing.
- form women's groups.

**Ministry of Education should include nutrition sensitive policies to**

- impart knowledge and promote skills needed to make and act on the most appropriate and positive decisions related to nutrition, growth, and development
- teach about nutrition and the ingredients for good nutrition
- take steps to keep adolescent girls and women in school (formal or non-formal education)

## *Symposium Lecture*

### **Development Sector in Nutrition Well-being and Community Empowerment: Are we on the right track?**



***Ms. Visakha Tillekeratne***

*Director MSDS, Consultant Food Technologist and Nutrition Expert*

**Preamble:** The world and Sri Lanka both may not know the beginning and end of community or individual empowerment. Social change is a continuous movement and changes from one extreme to another with the swing of the pendulum. Empowerment could be looked at through many lenses – social, gender, economic, health and political. Whatever the lens through which we look, it is important to start with a reasonable definition of community empowerment. Please note that the emphasis is on a **reasonable definition**. Whichever the lens, the resultant behavior after “empowerment” would be the same and the lens would read the same behavior regardless of the sector. Whether we are on the right track could only be ascertained after there is agreement on standards and definitions, agreed steps to community empowerment

**Definitions:**

**Robert Chambers;** who is considered one of the major gurus who looked at the mode of participatory development for communities to be empowered; Chambers has been one of the leading advocates for putting the poor, destitute and marginalized at the center of the processes of development policy. Cornwall and Scoones refer to him as "development's best advocate". **In particular he argues the poor should be taken into account when the development problem is identified, policy formulated and projects implemented.** He popularized within development circles such phrases as "putting the last first" and stressed the now generally accepted need for development professionals to be critically self-aware. This underpins the concept of “respecting each other” on a level playing field.

**The 7<sup>th</sup> Global Conference on Health provides the following definition;**

'Community empowerment refers to the process of enabling communities to increase control over their lives. "Communities" are groups of people that may or may not be spatially connected, but who share common interests, concerns or identities. These communities could be local, national or international, with specific or broad interests. Empowerment' refers to the process by which people gain control over the factors and decisions that shape their lives. It is the process by which they increase their assets and attributes and build capacities to gain access, partners, networks and/or a voice, in order to gain control.'

Community empowerment, therefore, is more than the involvement, participation or engagement of communities. It implies community ownership and action that explicitly aims at social and political change. Community empowerment is a process of re-negotiating power in order to gain more control. It recognizes that if some people are going to be empowered, then others will be sharing their existing power and giving some of it up. Power is a central concept in community empowerment and health promotion invariably operates within the arena of a power struggle.

Community empowerment necessarily addresses the social, cultural, political and economic determinants that underpin health, and seeks to build partnerships with other sectors in finding solutions.

### **Definition of Laverack**

"Enabling" implies that people cannot "be empowered" by others; they can only empower themselves by acquiring more of power's different forms.

### **Recognition of Empowerment:**

How do we know that communities are empowered? How do empowered communities behave?

The establishment of a naturally emerging functional leadership from the "open" community, with vibrant community structures, with equal dynamics among them, able to mobilize resources. This should be connected with individual control and positive relationships.

According to Laverack 2009 the steps to empowerment are;

- Community leadership
- Problem assessment capacities
- Local leadership
- Resource mobilization
- Organizational structures and links
- Ability to ask why? Critical consciousness (which is extremely lacking in Sri Lanka and later on this will be espoused)
- Community control over program management (which is not very often seen and this too will be proven with evidence)
- Equitable relationships with outside agents such as donors

Answering the question "Are we on the right track in Sri Lanka?"

The highlighted steps have not been achieved and

Evidence will be cited on the following to support the answer that we are only half way there".

The reasons being:

1. Lack of effective engagement (approaches and mechanisms) with marginalized groups
2. Lack of professional competencies to empower the people at all levels and different communities
3. Lack of scaling up successful bottoms up approaches to empowerment
4. Lack of evidence on the linkages between empowerment, the determinants of health and health outcomes.



## *Symposium Lecture*

### **Scaling Up Multi Sectoral Nutrition**



***Mrs. Dilka Rashmi Peiris***

*Project Director, Scaling Up Nutrition People's Forum, Sri Lanka*

Successful elimination and prevention of malnutrition requires a multifactorial, multi sectoral and multi stakeholder response. Malnutrition is a complex problem which requires multifaceted responses. Widely accepted UNICEF's conceptual framework suggests that the underlying causes of poor nutrition are lack of access to a nutritious diet, inadequate preventive and curative health and healthy environment and inadequate care including feeding practices. Each of these underlying causes are the results of multiple factors. Multisectoral approach refers to deliberate collaboration among various sectors (e.g., health, education, environment, and economy) contributing to jointly achieve a policy outcome of improved nutrition. Multi stakeholders are the various players (e.g., government, united nation organizations, civil society and private sector) engaged to address the nutritional problems, taking forward the policy actions. By engaging multiple sectors, stakeholders can leverage knowledge, expertise, reach and resources, benefited by their combined and varied strengths as they work towards the shared goal of producing better nutrition outcomes.

There are two complementary approaches to improve nutrition; direct - nutrition specific interventions and indirect - nutrition sensitive interventions, which is a broader multi-sectoral approach. Action on both nutrition specific and nutrition sensitive interventions is very much important and urgent to address the existing gaps in nutrition.

To address the nutrition gaps whilst collaborating with all stakeholders require more efforts to be taken by the governments and other contributors such as private sector, civil society organizations, donors etc. However, this creates complexities. Increased complexity introduces challenges that can interfere with large-scale implementation success. Because of this reason, some may not contribute, but implementation of a non-multisectoral program raises a question as to whether such programs could truly eliminate malnutrition, if they do not address all of its causes.

Some of the areas to be considered when implementing Multi Sector Programming are; 1). Creating an enabling political environment, with strong in-country leadership & a shared space (multi-stakeholder platforms) where people come together to align their activities & take joint responsibility for scaling up nutrition 2). Establishing best practices for scaling up proven interventions; including the adoption of effective laws & policies 3). Aligning actions across

sectors around high quality and well-costed country plans, with an agreed results framework and mutual accountability 4). Increasing resources for coherent, aligned approaches by various partners 5). Strong coordination and monitoring system at central level, there should be a coordinating and monitoring mechanism lead by higher government officials as different layers and sectors involve in this. There should be an accountability mechanism as well.

Considering multi sector collaboration as a mean to address under nutrition; Multi-sectoral approaches can help to reduce the under nutrition in three ways. Firstly, accelerating action on determinants of undernutrition like inadequate income and agricultural production or by improving gender equality and girls' education, which are known to have a powerful impact over time in preventing undernutrition. Similarly, improved water supply not only helps to address the cycle of disease and malnutrition but allow mothers to spend more time on nutrition and health of their children. Secondly, integrating nutrition, by including specific pro-nutrition actions in programs in other sectors. For example, school curricula should include basic knowledge of good nutrition, including family nutrition practices. The closest links, though, are to food security and agriculture, health and social protection, in which there are opportunities to contribute directly to better nutrition outcomes. To take the case of agriculture, there is a need to incorporate one powerful way to encourage more emphasis on nutrition objectives in related sectors and to hold those sectors accountable for nutrition results is to include an indicator of undernutrition as one set of indicators used to judge overall progress in these sectors. Thirdly, by increasing "policy coherence" through government-wide attention to unintended negative consequences on nutrition of policies in other sectors.

Successful malnutrition elimination at scale requires learning from the mistakes and successes of the past, as well as finding new approaches to deal with inherent challenges. The challenges in implementing multi sectoral programs include; 1). Competing parallel systems, structures and conflicting agendas and interests at different levels and ministries - multisectoral approaches can suffer due to differing cultures, mandates, and incentives characteristic of different sectors. These factors are barriers to coordination and cooperation. Some ministries may see nutrition as subordinate to their larger mandate such as agriculture, or as the responsibility of a different sector. 2). Lack of decision-making authority accompanied by limited capacity to position nutrition outcomes at the core of the development discussion - need for increased high-level commitment. Nutrition has been called "the forgotten sector"; it often falls within health, where it is treated as an infection and treatment issue, or with agriculture, where it often is assumed simply to be a product of food unavailability and/or poverty. 3). Limited coordination and capacity beyond the national level and limited engagement of local or community-based civil society organizations and private sector- identifying and establishing consensus about the minimum framework of interventions, from multiple sectors, to prioritize. This framework must contain all of the necessary intervention elements that support nutrition but cannot attempt to co-opt every intervention from every sector's full mandate. 4.) Equally important is technical consensus about how to solve the problem of malnutrition. The lack of capacity to implement is observed in many instances and varies among sectors. As a result, excellent policies and well-conceived technical approaches at the national level can fall apart at the level of implementation.

Planning for scalability is of utmost importance, and some general tips include; 1). Planning longer and short-term interventions aligning to policies, through research and by starting the multi sector action plans development together with all relevant stakeholders 2). Identifying the best collaborators and work closely together 3). Focusing on creating win-win situations, one of the best ways to ensure sustainability is to ensure that the various partners and stakeholders involved are truly invested in its success. 4). Recognizing that scaling is an active

process that requires constant learning as for some sectors nutrition is a new subject area. That might mean making use of framework guidelines, toolkits, checklists, or any other resources that already exist around or develop them 5). Establishing a strong coordination body to monitor and follow up of the implementation and scaling up of multi sector action plans and approaches.

Multisectoral models have become the overwhelming consensus for recent nutrition programming. “Scalability” and “Sustainability” have become catchwords in the global agenda. As Sri Lanka is facing a triple burden of malnutrition; stagnant situation of under nutrition, rising of non-communicable diseases and a burden of micronutrients diseases such as anemia; it is very much important to scale up this multi sectoral approaches to address the issues.

### ***Symposium 3: Nutraceuticals in Nutrition***

#### ***Symposium Lecture***

#### **Preclinical and Clinical Trials of Nutraceuticals for Diabetes**



#### ***Prof. Catherine B Chan***

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There has been an alarming increase in metabolic diseases worldwide, including type 2 diabetes (T2D) and obesity. Diabetes is a chronic disease marked by the presence of hyperglycemia that occurs when the pancreas cannot produce enough insulin, or the body cannot effectively use the insulin that is produced. Uncontrolled diabetes can lead to several serious complications such as cardiovascular disease, nephropathy, retinopathy, amputation and nerve damage. Well-managed diabetes can reduce the risk of these complications and increase life expectancy. The treatment of diabetes requires long-term self-management and adherence to therapy, but several commonly used drugs can cause side-effects, which could negatively impact adherence. As many as 25-57% of people with diabetes turn to complementary or alternative medicine, which includes natural health products, functional foods and nutraceuticals to treat their disease.

An alternative to pharmaceutical agents for the management of metabolic conditions is the use of functional foods or nutraceuticals. As defined by the European Commission Concerted Action on Functional Food Science in Europe and The International Life Sciences Institute Europe, functional foods are those that beyond their nutritional value can exert one or more physiological effects in the body in a manner that can improve health/well-being or reduce the risk of diseases. In Canada and elsewhere, nutraceuticals are defined as products derived from foods and sold in medicinal forms, whereas functional foods are similar to conventional foods. Some nutraceuticals are peptides derived from food proteins. These peptides are produced enzymatically or using fermentation under controlled conditions of pH and temperature. Food protein-derived bioactive peptides have shown vast potential for the management of cardiovascular diseases, obesity, and diabetes. However, according to Canadian guidelines for the use of complementary and alternative medicine for diabetes treatment, only marine collagen peptides were identified as having clinically relevant improvement in blood glucose control in human trials.

In addition to the lack of clinical trials, the defined mechanisms of action to prove efficacy of nutraceuticals are only just emerging in preclinical studies. Therefore, understanding the

mechanism of action of EW peptides is an important step toward clinical trials and the future development of a product for the management of T2D.

One widely available source of bioactive peptides is hen egg. Egg peptides are reported to impact the renin-angiotensin system (RAS) as well as inflammation and oxidative stress. Disturbances of RAS along with a pro-inflammatory, pro-oxidative state are observed in obesity and diabetes. Thus, it is of interest to study egg peptides in terms of their anti-diabetic and anti-obesity properties.

Our research group has conducted extensive characterization of the biological properties of several egg peptides. The general approach is to first examine peptide mixtures for their efficacy to modify endpoints in cell culture models of disease, for example in skeletal muscle or adipocyte cells treated to mimic insulin resistance. Once efficacious peptides are identified, feeding trials in rats or mice are initiated. Recently, we reported that a hydrolysate prepared from egg white reduced blood pressure in hypertensive rats by inhibiting the RAS system. In prediabetic rats, the same hydrolysate activated insulin signaling pathways in skeletal muscle and white adipose tissue and these molecular effects were associated with improved glucose tolerance in vivo. Other authors, using hydrolysate prepared under different chemical conditions, also report benefits on glucose metabolism. Many questions remain as to how peptides are influenced by the host's digestion, their bioavailability and interaction with host tissues.

Few human clinical trials using egg peptides or hydrolysates to improve diabetes-related outcomes have so far been reported. Six studies were identified on ClinicalTrials.gov, one of which was published in a peer-reviewed journal. In that trial, NWT-03, which had demonstrated efficacy to inhibit angiotensin converting enzyme (ACE) activity in a rat model, was provided to healthy human participants with normal, high-normal blood pressure or mild hypertension. The purpose was to establish a dose range and safety of NWT-03 and a crossover design was used (Plat et al. 2017). A dose of 2 g/day had mild effects on blood pressure that was not increased at a dose of 5 g/day. The authors suggested caution in interpretation of the results.

To summarize, while peptides from eggs and other sources such as fish, whey and soy exhibit diverse bioactive properties in tissue and animal model systems, there are as yet few clinical trials that support their therapeutic application. Scientific studies of many other nutraceuticals are similarly in relatively early stages.

## *Symposium Lecture*

### **Advances in Delivery Systems for Bioactives**



***Prof. Feral Temelli***

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With the continuing growth of the functional food and natural health product industries, the demand for functional ingredients has also been on the rise over the past two decades. Physical functionality refers to how the ingredients function within the food product, including their solubility, thickening, gelation, foaming and emulsifying properties; whereas, physiological functionality refers to how they function in the body after consumption of the food. Functional foods have physiological benefits beyond providing basic nutrition function and are formulated to contain ingredients with such functionality. Therefore, development of functional ingredients, focusing on the delivery systems for bioactives with various health benefits has received tremendous interest, leading to numerous novel approaches in recent years.

As macronutrients, proteins, carbohydrates, specifically polysaccharides, and lipids are being used in different ways as delivery systems for bioactives in the form of various macro- and microstructures. Such structures include simple and double emulsions, the use of Pickering particles and shells, nanoparticles, liposomes, gelled networks, fluid gels and gel particles, and encapsulated systems among others. One goal of such structures is to protect the bioactives from external factors like oxygen, pH, heat, light etc. and minimize their degradation and enhance their stability throughout processing and storage since the majority of bioactives are sensitive to these factors. Another major goal is the targeted delivery of bioactives to certain sites in the gastrointestinal tract of the body and their controlled release over time. These concepts have been used successfully for drug delivery by the pharmaceutical industry and have also been adopted by the functional food and natural health product industries. Such approaches are especially important for hydrophobic bioactives such as carotenoids, phytosterols, curcumin, coenzyme Q10 (CoQ10) and fat-soluble vitamins (vitamins A, D, E, and K) to enhance their bioavailability and ease of formulation in aqueous-based products.

Different techniques are used to obtain the various macro- and microstructures needed for the delivery of bioactives. Spray drying, coacervation, extrusion, gelation using polymers such as alginates and fluidized bed are some of the techniques used for the encapsulation of bioactives. However, there are some concerns associated with some of these traditional techniques, including the use of high temperatures or organic solvents that can lead to degradation of bioactives and loss of biological activity, difficulties in controlling particle characteristics,

low encapsulation efficiencies and yields and in some cases difficulties in scale up. On the other hand, the use of pressurized fluids, including supercritical carbon dioxide (SC-CO<sub>2</sub>) offers various advantages and numerous particle formation techniques have been developed over the past two decades where particles with controlled properties and thus functionality can be obtained. Tuneability of the parameters involved in supercritical processes, such as temperature, pressure, nozzle diameter and depressurization rate, allows the control of particle size, particle size distribution and morphology. Also, the capability to process at relatively low temperatures

allows handling of heat-sensitive materials. Avoiding the use of organic solvents or efficient removal of such solvents when included in the process is another major advantage of using pressurized fluids for the formation of particles, targeting functional food ingredients.

Building on the success of extraction of bioactives from various sources using SC-CO<sub>2</sub> with numerous commercial plants in operation worldwide, the focus has shifted to the development of bioactive delivery systems. Various supercritical particle formation processes have been developed where the CO<sub>2</sub> functions as a solvent, co-solvent, anti-solvent or solute. The resulting nano/microparticles have morphologies and functionalities superior to those generated by conventional techniques. Several processes have been developed in our lab, targeting the delivery of hydrophilic and hydrophobic bioactives. Lipids, polysaccharides and proteins are used as the carrier materials. Solid lipid particles were prepared taking advantage of the melting point depression of solid lipids saturated with CO<sub>2</sub> under high pressure. Upon rapid depressurization of the CO<sub>2</sub>-saturated lipids, micro/nano particles are formed, which can be used as a carrier for bioactives. Solid lipid particles were loaded with lutein or vitamin B2 upon depressurization into air or water environment, respectively. Liposomes were prepared by pressurization of soy lecithin+bioactive dispersion in water with CO<sub>2</sub> followed by rapid depressurization. Nano-scale unilamellar vesicles of liposomes loaded with lutein or anthocyanin with a narrow particle size distribution were obtained. The anthocyanin release from liposomes was slow ( $\leq 35.9\%$ ) in the simulated gastric fluid but rapid in the simulated intestinal fluid while protecting the anthocyanin. In the case of CoQ10, loss of crystallinity upon loading into liposomes showed potential for enhanced bioavailability of this potent antioxidant.

The recent development of the PGX (Pressurized Gas-eXpanded liquid) technology led to new opportunities for the use of polysaccharides and proteins as delivery systems. PGX-processed biopolymers with a morphology of aggregates of nanoparticles have very low bulk density ( $< 0.08$  g/mL) and very high surface area ( $> 100$  m<sup>2</sup>/g). Thus, they can be loaded with bioactives in the second step by employing adsorptive precipitation using SC-CO<sub>2</sub>. PGX processing was applied to oat  $\beta$ -glucan, gum arabic and sodium alginate, followed by adsorptive precipitation of CoQ10. Among the three biopolymers tested, the highest loading of CoQ10 of 46.9% (wt/wt) was obtained with sodium alginate at 200 bar and 40°C. When the surface area of the particles is taken into consideration, the CoQ10 loading was 14.1 mg/m<sup>2</sup> of sodium alginate, compared to 1.4 mg/m<sup>2</sup> of gum arabic and 8.8 mg/m<sup>2</sup> of  $\beta$ -glucan. Thus, the specific interactions between the bioactive and biopolymer play an important role and better understanding of these interactions is needed. Loss of crystallinity of CoQ10 to a certain extent was demonstrated after the adsorptive precipitation process by XRD and DSC analysis, which may lead to enhanced bioavailability. Loading of CoQ10 on these PGX-processed polysaccharides allowed its dispersion in water with ease, which was reasonably stable over time. In addition, CoQ10-loaded  $\beta$ -glucan was used in the formulation of a functional beverage and assessed by a consumer panel.

Fat-soluble vitamins D<sub>3</sub> and E were also loaded on PGX-processed gum arabic and sodium alginate using adsorptive precipitation with SC-CO<sub>2</sub>. Loading of these vitamins on sodium alginate was higher (13.7±0.1% for Vit D<sub>3</sub> and 22.35±0.1% for Vit E). However, sustained release of both vitamins in the simulated intestinal fluid was higher for the loaded-gum arabic samples, demonstrating stronger interactions between sodium alginate and vitamins.

These examples demonstrate the great potential of SC-CO<sub>2</sub> technology for particle formation as delivery vehicles for bioactives. It is important to better understand the relationships between product functionality and processing parameters so that optimal processes can be designed to produce ingredients with maximum functionality and bioavailability. Considering the growing demand for functional food ingredients with health benefits, ingredients produced using SC-CO<sub>2</sub> particle formation technologies show great potential for further development, targeting food and natural health product applications.



## *Symposium 4: Food & Nutrition in Natural Disasters*

### *Plenary Lecture*

#### **Tackling nutritional challenges for future generations through sustainable food system approach**



***Prof. K.D.R.R. Silva***

*Professor of Nutrition, Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka*

By 2050, the world's population is estimated to reach a record over 9 billion people. This projected rise, coupled with rapid urbanization, will create many challenges in nutrition. The 17 UN Sustainable Development Goals (SDGs) provide a blueprint for sustainable global development for current and future generations. SDG-2 focuses on food security and nutrition, specifically targeting zero hunger, achieving food security, eliminating malnutrition in all its forms and promoting sustainable agriculture. SDG-12, a related goal, calls for responsible production and consumption. Although advances in agriculture, including biotechnology, have resulted in major gains in food security, nutrition, poverty alleviation, employment and overall development, future challenges to agriculture are daunting. Present day world agriculture is facing several challenges: how to feed a growing world population for its nourishment, how to reduce rural poverty in the world and how to manage ecosystem goods and services in light of global environmental change.

It is true that the advances in agriculture have resulted in a significant decrease in protein/calorie malnutrition. Many public health problems have actually increased as evidenced by dramatic increases in obesity and related non-communicable diseases. Moreover, micronutrient malnutrition still affects a substantial portion of the earth's population. Agriculture, public health and the environment are strongly interconnected and achieving successes in all areas will require a novel, cross-disciplinary, multifaceted and interacted model.

The UN has emphasized the necessity of sustainable food systems for promoting healthy diets. As defined by Food & Agriculture Organization, food systems gather all the elements (environment, people, inputs, processes, infrastructure and institutions) and activities related to the production, processing, distribution, preparation, and consumption of food. A sustainable food system further extends this concept and includes food systems that ensure food security and nutrition for all, without compromising the socioeconomic, environmental, and social bases for current and future generations. Three core constituent elements of food

systems have been identified in the conceptual framework proposed by High Level Panel of Experts: food supply chains, food environments and consumer behaviour. These elements, which are influenced by number of drivers, shape diets and determine the final nutrition, health, economic and social outcomes of food systems.

The decisions made by one group of actors at one element of the chain have implications for the others. These decisions influence the way food is produced and processed along the supply chain and impact the four dimensions of Food Security and Nutrition; availability; access, whether physical or economic; utilization; and stability), as well as the nutritional value of the food produced and processed. For instance, food supply chains can increase the nutritional value of food, by increasing access to macronutrients as well as micronutrients through biofortification, food fortification or improved storage of perishable foods (such as fruits and vegetables), or by reducing the levels of substances associated with diet-related non-communicable diseases (e.g. trans fat, high levels of sodium) during food formulation. However, the nutritional value of food can also diminish along the food supply chain (e.g. in the case of food losses and contamination).

Traditionally, a single element of this system such as food production system (crop, animal and aquaculture production system) or components of value chain or consumption has been focused to improve the efficiency of the whole system. There is a clear linkage between nutrition situation and good health and wellness of people and the agriculture sector. Main role of agriculture sector is to produce food for human consumption. Though close relationship is obvious among three players namely, agriculture, nutrition and health, connection is missing among priorities of nutritious food production and their consumption by the population. Over the last few decades, it has been recognized that a more holistic approach is needed to address these complex and interconnected nodes and issues. As a result, a food systems approach has been widely adopted to assess, analyse and identify the role of different actors, activities and outcomes of the system and to identify intervention points for enhancing food security.

Positive growth in agricultural production does not guarantee a healthy, sustainable diet. There is growing recognition that “nutrition-sensitive” development is necessary to ensure nutrition security and to reduce malnutrition. Although agriculture has the potential to be a strong driver of malnutrition reduction, food security and serves as the main source of livelihood for nearly 50% of Sri Lanka’s population, its potential to reduce malnutrition is currently not being utilized or not given priority. It has been acknowledged that “nutrition-sensitive” approaches (including those involving agriculture) that complement “nutrition-specific” interventions are required to achieve nutrition security and reduce undernutrition. There is an overarching need to create an “enabling environment” built on “policies and processes to sustain momentum” in reducing undernutrition.

The current global outbreak of Coronavirus (COVID-19) has disrupted food systems around the world. Restrictions on movement within and across countries can hinder food-related logistic services, disrupt entire food supply chains and affect the availability of food. Impacts on the movement of agricultural labour and on the supply of inputs are expected to critically challenge the food production, thus threatening food security for all people, and hit especially vulnerable populations such as children and the elderly and people living in the poorest countries. It has also led to reduced productivity in food processing and distribution plants, or even food processing plant closures. Processing plant closures in some countries in turn have caused backlogs on farms, with serious implications for the management of ongoing harvests/production. Similarly, processing restrictions will eventually impact the availability of products to consumers. Furthermore, some areas of the world could experience an increase

in food prices. Global models predict that the number of people living in poverty could substantially increase or aggravating poverty and hunger in developing countries. Food insecurity and low-quality diets cause undernutrition, micronutrient deficiencies, and rising overweight and obesity rates, which in turn are notable risk factors for admission to hospital and death due to complications from COVID-19. Decisive collective action is needed to ensure that this pandemic does not threaten food security and nutrition, and to improve resilience to future shocks.

In conclusion, the challenges in food and nutrition related issues will further hampered due to 2020 COVID-19 crisis. The countries are unprepared to respond appropriately to the pandemic and its consequences in food and nutrition security. In the “post-COVID” era, the policy makers, public health professionals and nutrition experts must join hands with agriculture sector to turn the current crisis into an “opportunity to build back, better and stronger” sustainable food system to tackle future nutrition challenges.

## *Symposium Lecture*

### **Maternal and Childhood Nutrition in Natural Disasters**



***Prof Pujitha Wickramasinghe***

*Senior Professor in Paediatrics, University of Colombo, Sri Lanka.*

Maternal and child malnutrition is a serious public health problem that would be experienced after any disaster whether natural or man-made, domestic, local or global. In a globalized world and being highly dependent on international trade, this has made it affects entire world. This would result in food and nutrition insecurity in the short term following any form of natural disasters, which up to now was mostly considered to be weather related. But the current COVID-19 pandemic has given a new perspective to natural disasters where the effects would be generation long. Natural disasters would affect food production, storage, distribution and preparation. Effect on mother's nutrition directly impact new born and infant.

Depending on the time and duration it affects the outcomes would vary ranging from simple micronutrient deficiency to acute and chronic undernutrition. Overall it has a negative effects on the growth of children. However, timely intervention with appropriate intervention (food fortification, supplementation, or behavioural and regulatory interventions) would help to recover and retain normal growth.

Although it is not in the list of conventional disasters, it is a new form which has an impact on the health and economic metrics globally, affecting nutrition of all walks of life young and old. Poverty, under-coverage of essential interventions, effect on food production and distribution and limited access to foods, breaks down in social security systems have contributed to acute malnutrition in mothers and children mainly in the lower socio economic sector. However, this has given rise to overnutrition as well in the more affluent part of the society, due to ability of high purchasing power, lack of exercise and involvement in more sedentary behaviour.

In this form of new disaster the interventions are long term than short term. Long term programmes at policy levels in form of strengthening the food-supply chain, improve social safety net programs, payment deferrals, or tax breaks and cash supports for the most vulnerable. Targeting the most marginalized households in rural and urban slums could be achieved through deploying community health workers and mother support groups. Global health and improvements in malnutrition will require governments, donors and development partners to re-strategize and re-prioritize investments and programmes that would necessitate data-driven decision making, political will and commitment and international support.

## *Symposium Lecture*

### **Harnessing Biodiversity for Food and Nutrition**



***Dr. W. L. Gamini Samarasinghe***  
*Additional Secretary, Ministry of Agriculture*

Present food systems are mainly derived from a narrow range of crop species where rice, maize and wheat account for more than 50% of calories consumed with a limited nutritional value. Multiple burdens of malnutrition problems are arising in low to middle income countries being the victims for poor nutrition. Continuous disregard of the rich agro biodiversity composed of nutritionally rich plants, orphan crops, traditional and wild edible varieties have lead towards unbalanced diets leading poor nutritional uptake. Thus local agro biodiversity is an essential part towards a sustainable food system enriched through food and nutritional security. Creative approaches are required to ensure proper utilization of rich agro biodiversity and its integration in to present day agriculture. Improvement of food systems will create greater diversity on our plates and in our diets. Sri Lankan agro biodiversity encompasses vast array of cultivated and wild crop species, landraces and traditional varieties if utilized effectively will contribute immensely towards food and nutrition security of the country. Food composition analysis of sixty eight priority agro biodiverse species, thirty underutilized crops including fruits vegetables and leafy vegetables revealed the vast harbor of nutrients comprised in these species with valuable macronutrients such as carbohydrates, proteins and fats, micronutrients such as vitamins and minerals that contribute to dietary health and nutrition. Traditional rice varieties were significant with the Iron and fiber content. Leafy vegetables including *Alternanthera sessilis*, *Amaranthus viridis*, *Centella asiatica*, *Sesbania grandiflora* displayed higher levels of micro nutrients including Iron. Local yams contributed towards significant amounts of carbohydrates, proteins, vitamins and minerals. These values provides evidence for the nutritional capacity of local agro biodiversity yet creating a momentum towards conservation and sustainable utilization of these crop species. Diversified food systems together with sustainable and healthy diets necessarily achieved through local solutions harnessed from existing agro biodiversity. consumer awareness of the desirability of these alternative foods so that they may more easily be incorporated in diets, food systems and markets need to be emphasized to move forward Sri Lanka to achieve food and nutrition security through conservation and sustainable use of local agrobiodiversity.

**ABSTRACTS OF ORAL PRESENTATIONS**

## Comparative Effect of *In vitro* Pancreatic Lipase Inhibitory Activity of Five Sri Lankan Medicinal Plants

M.H.N. De Zoysa<sup>1</sup>, J.A.N. Sandamali<sup>1</sup>, and R.P. Hewawasam<sup>2\*</sup>

Obesity is one of the main public health problems in developed as well as developing countries. It is a significant risk factor for the development of chronic diseases including metabolic syndrome, cardiovascular diseases and diabetes. Inhibition of pancreatic lipase is one of the approaches used to treat obesity due to the fact that majority of dietary fat is hydrolyzed by pancreatic lipase. Medicinal plants may provide a safe, natural and cost-effective alternatives to synthetic anti-obese drugs which are high priced. Furthermore, they sometimes lead to adverse effects. The main objective of the present study was to determine the effect of five medicinal plants on the inhibition of pancreatic lipase activity *in vitro*. Ethical clearance was obtained from the Ethical Review Committee, Faculty of Allied Health Sciences, University of Ruhuna. Ethanol and hexane extracts of medicinal plants, *Allium sativum* (Garlic - fruit), *Trigonella foenum-graecum* (fenugreek - seeds), *Tinospora cordifolia* (Rasakinda - stem), *Terminalia chebula* (Myrobalan - fruit) and *Bacopa monnieri* (Lunuwila - whole plant) were evaluated for their potential anti-lipase activity. Six different concentrations (25, 50, 100, 150, 200, 400 µg/mL) of each plant extract and the porcine pancreatic lipase, *p*-nitrophenyl butyrate and the buffer solution were added to respective wells of micro-titre plates separately and incubated at 37°C for 30 min. Hydrolysis of *p*-nitrophenyl butyrate to *p*-nitrophenol was measured at 405 nm to determine the pancreatic lipase activity. Experiments were carried out in triplicate and percentage inhibition of pancreatic lipase activity was determined. Percentage of inhibition at 400 µg/mL concentration of ethanolic garlic, fenugreek, myrobalan, rasakinda and lunuwila extracts were 64.5, 68.2, 84.4, 87.9 and 74.2%, respectively. The corresponding values for hexane extracts were 53.2, 39.6, 48.7, 75.2 and 77.5 % The positive control, orlistat yielded 91.9%. Ethanol extracts showed higher anti-lipase activity compared to the hexane extracts and *Tinospora cordifolia* (Rasakinda) showed its potential to be used in the development of an anti-obesity drug compared to other extracts.

**Keywords:** Ethanol, Hexane, Medicinal plants, Pancreatic lipase.

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## Farmers' Perception on Nutrition Sensitive Agriculture

K.A.C. Madumali<sup>1</sup>, C.C. Ranasinghe<sup>1</sup>, A. Chandrasekara<sup>1</sup> and K.D.R.R. Silva<sup>1\*</sup>

Nutrition-sensitive agriculture approach seeks to make the food system better equipped to produce good nutritional outcomes in a country. A Community based qualitative research was carried out to investigate the readiness of farmers in incorporating nutrition into their farming. Sixteen focus group discussions (four from each Kurunegala, Anuradhapura, Nuwara Eliya and Jaffna districts) were conducted with farmers (crop, livestock and aquaculture) who were selected through purposive convenient sampling method. The locations were selected to represent the farmers who are engage in different types of farming (paddy, vegetable, fruits cultivation and home garden). Ethical approval was obtained from the Ethics Review Committee, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka. Discussions were carried out to cover three main domains; knowledge, perceptions and practices of farmers. The majority of the farmers showed confusion over terms 'nutritious foods' and 'safe foods'. The main focus of the farmers was to have a higher profit rather than having nutritious foods. Therefore, the crop farmers mainly selected high yielding, highly demanded crop varieties. Considerable proportion of livestock farming families did not consume milk (their produce) daily while almost all the inland fishery families consumed fish (their produce) daily. The nutrition literacy was very poor among all farmers that they even did not know the nutritional importance of their produce. Majority of the farmers expressed their willingness to consider nutrition in their farming and promote nutritious foods and nutritional importance of foods including crops, fish, egg and milk. But they claimed that consideration of nutrition in farming might cause low market opportunity to sell their products and finally it affects their total income and profit. The present study provides evidence that the farmers are not adequately aware of means of integrating nutrition into their farming practices and processes beyond the farm gate. Hence, farmers must be empowered and facilitated to incorporate nutrition into agriculture sector in Sri Lanka.

**Keywords:** *Farmers, food system, nutrition sensitive agriculture, nutritious foods*

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## Changes of Fatty Acid Profile Associated with Deep-Frying of Potato Slices in Three Different Edible Oils

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Edible oils undergo different chemical changes such as hydrolysis, thermal oxidation, polymerization and isomerization. Therefore, frying can be considered as one of the major culinary operations of *trans* fatty acid (TFA) generation. The objective of this study was to assess the changes occur in the fatty acid profile and quantify TFA generated in frying oils and fried products during reuse. Coconut, Refined Bleached Deodorized (RBD) palm and RBD soya bean oils were used as frying oils to fry potato slices. Oils were heated to 170 °C for 12 minutes in pans and potato slices of equal thickness and diameter were fried separately over 3 min at the same temperature, maintaining potato to oil ratio of 1:8.5. On completion of the first frying cycle, a sample of oil and fried potato chips were collected. The same oils were reused for frying a fresh batch of potato slices after a lapse of 24 h and frying was continued up to five cycles. The fatty acid profile and TFA content of the frying oil and potato chips were determined using gas liquid chromatography. TFA content of potato chips fried in soya bean and palm oils at the end of the 5<sup>th</sup> cycle was 1.5 and 1.1%, respectively, while that of soya bean and palm oil samples was 3.6 and 1.3%. Neither coconut oil nor chips fried in coconut oil showed detectable levels of TFA at the end of the 5<sup>th</sup> cycle. Monounsaturated fatty acid content in coconut oil had decreased with the frying time while soya bean and palm oil did not show any significant changes in their fatty acid profiles. Coconut oil showed a better stability against thermal oxidation than palm and soya bean oils in frying potato slices.

**Keywords:** *Fatty acid profile, Gas Liquid Chromatography, Thermal oxidation, Trans fatty acids*

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## Sri Lankan Traditional Rice: Is Parboiled Rice Good for Lowering Glycaemic Response?

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Rice is the dietary staple of Sri Lankans, which contributes to the total carbohydrate and energy intake. The objectives of the present study were to investigate the effect of parboiling on glycaemic response and glycaemic indices (GI) of some differently processed traditional rice varieties namely *Goda heenati*, *Batapolael*, *Dik wee*, *Dahanala*, *Unakola samba* and *Hangimuththan*. Each variety was raw, under milled (R), polished (RP) (4%) and parboiled (without polishing) and cooked as per home cooking prior to analysis. GI was determined by WHO standard method. Glucose standard (50 g) and rice portions containing 50 g of digestible starch were given to 10 apparently healthy volunteers. ERC was obtained from Ethic review committee, Faculty of Medical Sciences, University of Sri Jayewardenepura (72/17). The GI values were expressed as (mean  $\pm$  SEM). Data were analyzed by SPSS. The glycaemic response curves obtained following consumption of 50 g carbohydrate portion of differently processed rice, the average peak glucose responses were observed at 30-40 min following ingestion and peak reductions ranged between 3.2- 34.4% compared to standard glucose where parboiled had the highest reduction percentage. The GI of all the parboiled rice were categorized as low ( $\geq 55$ ) while two raw varieties (*Batapola el* and *Hangimuththan*) were also having low GI and other four raw varieties were categorized as medium GI (56- 69). However, raw polished varieties elicited high GI ( $\leq 70$ ) except for raw polished *Dahanala* (medium GI). Glycaemic load (GL) for the portions given for GI determination were categorized as high ( $>20$ ) for all varieties irrespective of processing. However, for an edible portion all the parboiled varieties contained a medium GL whereas GL of raw and raw polished remained as high. Thus, parboiled and under milled traditional rice varieties can be recommended for consumption by individuals seeking to control the blood glucose levels.

**Keywords:** *Diabetes, glycaemic index, glycaemic load, parboiled rice, raw rice.*

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## Presence of Pesticide Residues in Selected Vegetables Grown in Conventional Agricultural Fields and Good Agricultural Practices (GAP)-Certified Fields

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Adoption of recommended Good Agricultural Practices (GAP) has been identified as an option to ensure safe and sustainable farm produce. Sri Lanka Good Agriculture Practices (SL-GAP) was launched with the assistance of the Department of Agriculture, Sri Lanka, in 2016, aiming at supplying safe produce to consumers. The main objective of this study was to compare between GAP certified agricultural produce and conventionally farmed agricultural produce, mainly the vegetables for the presence of pesticide residues for a selected number of pesticides. Simple random sampling was performed at ten selected sites belonging to Nuwara Eliya and Puttalam districts in order to collect vegetable samples. Sample extraction was performed according to the Association of Analytical Communities Official Method 2007.01 and analysis was done using liquid chromatography-tandem mass spectrometry. Of 26 pesticides, 16 pesticides were absent in any of the samples tested. Moreover, there was no association ( $p>0.05$ ) between, the type of farming system vs. presence of any pesticide residue and selected district vs. presence of any pesticide residue. However, presence of residues of Carbendazim was significantly different ( $p<0.05$ ) between samples collected from GAP fields and conventionally farmed fields where the presence of Carbendazim residues in conventional farming system was higher than that of GAP certified fields. Any of the observed levels of tested pesticide residues in produce obtained from both farming systems did not exceed the Maximum Residue Levels (MRLs) specified by the Codex Alimentarius Commission and the MRLs issued by the Extraordinary Gazette no. 2023/34 dated 14.06.2017 issued by the Government of Sri Lanka. The SL-GAP project is gaining its success since there is no significant hazardous amounts of pesticide residues present in any of the samples subjected to analyses. It is advisable to disseminate this information among farming communities, through the agriculture extension network so that they could adopt appropriate controlling measures to further ensure the quality and safety of their produce.

**Keywords:** *Good Agricultural Practices (GAP), liquid chromatography-tandem mass spectrometry (LC-MS/MS), maximum residue levels (MRLs), pesticide residues.*

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## Nutritional Status, Macronutrients and Water intake in a Group of Patients with Urolithiasis Managed at Teaching Hospital, Karapitiya

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C.J. Wijesinghe<sup>3</sup> and S. Goonesinghe<sup>4</sup>

Urolithiasis is a common disease, which occurs due to the supersaturation of minerals in urine causing precipitation and crystal formation. Urolithiasis is of multifactorial origin and diet plays a major role in the development of disease. We aimed to describe the nutritional status, water and macronutrients intake of a group of patients with urolithiasis. A cross-sectional descriptive study was conducted among patients with urolithiasis managed at the urological surgical unit in the Teaching Hospital, Karapitiya, Sri Lanka after obtaining the consent. Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Ruhuna. Data on baseline information, regular water and nutritional intake were collected. Macronutrient intake was estimated using Nutrisurvey software. There were 126 (54.8%) males and 104 (45.2%) females in the aged range of 20-70 years (median=53) and 49 (21%) were  $\leq$  40 years old. Diabetes mellitus, hypertension, hypercholesterolemia, smoking (ex-smokers and current smokers), alcohol consumption (past and present) were observed in 60 (26.0%), 57 (24.8%), 58 (25.2%), 70 (30.4%) and 84 (36.5%) patients, respectively. Mean Body Mass Index was  $24 \pm 4$  kg/m<sup>2</sup>. There were 142 (61.7%), 73 (31.7%) and 15 (6.6%) patients with overweight/obesity, normal and underweight, respectively. Median water intake was 2.0 (0.5- 7.0) L in comparison to recommended water intake (1.2 -3.4 L) based on the body weight. Among them, 92 (40%) were not taking recommended volume of water per day. Median daily intake of calorie, carbohydrate, protein and fat were 1886 (902 –3561) kcal/day, 333(149–697 g/day), 43.4 (17.5–110 g/day) and 37.8 (9.5-106 g/day), respectively. Mean percentage (SD) of energy supply from carbohydrate, fat and protein were 72.2 % (5.1), 17.7% (4.0) and 10.1% (2.0), respectively. There were 87 (38.3%), 152 (66.6%), 13 (5.6%) and 49 (21.6%) patients who consumed more calories, carbohydrate, fat and protein than recommended, respectively. There were no vegetarians in the group. There is a considerable number of young patients in the group. Known risk factors of urolithiasis such as obesity, diabetes mellitus, hypertension, hypercholesterolemia, smoking, low fluid intake, consumption of energy and protein rich diet are prevalent in the group.

**Keywords:** *Macronutrients, nutritional status, risk factors, urolithiasis, water intake.*

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## Association of Protein Intake with Bone Turnover Markers and Bone Mineral Density in a Group of Community Dwelling Adult Women

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Nutrition, especially protein intake, is crucial for bone health throughout life. We assessed the association of protein intake with bone turnover markers (BTMs) and bone mineral density (BMD) in a group of adult women. Ethical approval for the study was obtained from the Ethical Review Committee, Faculty of Medicine, University of Ruhuna. Women aged >20 years in Bope-Poddala MOH area, Galle district were recruited using age stratified random sampling method and categorized as premenopausal (n=201) and postmenopausal (n=136). Postmenopausal status was defined as the presence of amenorrhea for more than 12 consecutive months due to natural causes. Cross linked C-telopeptide of type I collagen (CTX; bone resorption marker) and procollagen type I N-propeptide (PINP; bone formation marker) were measured using ELISA. Regional and total body BMDs were measured by DXA. Dietary intake was assessed by a food frequency questionnaire and protein intake was estimated using NutriSurvey database which was validated for Sri Lanka. Partial correlations (adjusted for age) was used to assess the correlations. In premenopausal women protein intake showed significant positive correlations with BMDs of hip, femoral neck, lumbar spine and total body ( $r$  range = 0.21 to 0.29,  $p < 0.01$ ). In postmenopausal women protein intake showed significant positive correlations with BMDs of hip, femoral neck, lumbar spine and total body ( $r$  range = 0.19 to 0.25,  $p < 0.05$ ). Protein intake showed significant negative correlation with CTX ( $r = -0.19$ ,  $p = 0.006$ ) in premenopausal women but not in postmenopausal women. PINP did not show significant correlations with protein intake in either group. High protein intake is associated with higher regional bone mineral density in both premenopausal and postmenopausal women in this study. The association of protein intake with bone turnover markers is less clear among them.

**Keywords:** Bone mineral density, bone turnover markers, protein intake, women.

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## Phase Angle and Hydration Status between Physically Active and Inactive Undergraduates of Sri Lanka: A Cross Sectional Study

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The phase angle (PhA) has been directly measured by bioelectrical impedance analysis (BIA): the ratio of reactance ( $X_C$ ) to the resistance (R). PhA is an indicator of nutritional assessment, cellular health, and cellular integrity. This study aimed at comparing the PhA and hydration status between physically active and inactive undergraduates. This was a cross-sectional study and the participants were selected using a stratified sampling technique. Among them, there were 58 males with a mean and SD of  $23.5 \pm 1.5$  years, height ( $170.1 \pm 7.7$  cm), weight ( $64.7 \pm 14.2$  kg) and 69 females with mean age of  $23.4 \pm 1.3$  years, height ( $158.2 \pm 5.5$  cm), weight ( $51.9 \pm 8.9$  kg). Physical activity level was evaluated based on the International Physical Activity Questionnaire (IPAQ), PhA, and hydration status were assessed by Multifrequency Tanita Body Composition Analyzer (MC-780). Statistical analysis was performed using Minitab version 18, as well as two-sample t-test and Pearson correlation test used to analyze the data. There were 23% (n =29) males and 29% (n =37) females identified as physically inactive undergraduate. According to the two-sample t-test, a significant difference ( $P < 0.05$ ) of mean PhA was observed between physically active ( $6.1 \pm 0.6^0$ ) and inactive ( $5.8 \pm 0.7^0$ ) undergraduates. Higher mean PhA values were observed in both physically active males ( $6.3 \pm 0.6^0$ ) and females ( $5.7^0 \pm 0.5$ ) compared to physically inactive males ( $6.2^0 \pm 0.6$ ) and female ( $5.3^0 \pm 0.5$ ). The percentage of Total Body Water (TBW %) was higher in the physically active group ( $51.9 \pm 8.1\%$ ) compared to the inactive group ( $49.0 \pm 5.2\%$ ). Mean of Intracellular Water (ICW) in the physically active group was higher ( $17.6 \pm 3.6$  kg) compared to physically inactive group ( $16.3 \pm 3.7$  kg). Mean of Extracellular Water (ECW) in the physically active group was higher ( $11.7 \pm 2.2$  kg) compared to physically inactive group ( $11.3 \pm 2.2$  kg). According to the Pearson correlation test, a significant strong positive relationship was observed between PhA value and TBW, ECW, ICW in both physically active and inactive ( $P < 0.05$ ) participants. PhA values positively correlated with TBW, ECW, ICW. PhA and hydration status were significantly low in physically inactive undergraduates as compared with physically active.

**Keywords:** BIA, Cellular Health, Cellular Integrity, Hydration Status, Phase Angle

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## Malnutrition and Associated Factors Among School Aged Children in Urban Sri Lanka

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Child malnutrition is a major public health concern that can have long-lasting impacts as children and in their adult life as well. This constitutes a major barrier to economic and sustainable development for a developing country like Sri Lanka. Malnutrition is seen to be associated with poor sanitation and low socioeconomic factors around the world. The objective of this study was to explore the malnutrition – related factors among urban school going children of Sri Lanka under the age of ten. A community based cross-sectional study was carried out in schools to determine the nutritional status of preadolescent school children in Colombo district. Anthropometric, household, and demographic data were collected from 150 students below the age of ten. Z-scores were computed for the three indicators of malnutrition: stunting, wasting and underweight. Collected data were analyzed using a logistic regression model to assess the associated factors of malnutrition. The prevalence of stunting, wasting and underweight among the children were 7.3%, 18%, and 24% respectively. Age of mother at childbirth, household income, and consumption frequency of fruits per week showed a significant impact on the child malnutrition. A difference in malnutrition status was observed between male and female children. Age of the mother was a key determinant for both stunting and underweight conditions among the children. A unit increase in mother's age could reduce stunting and underweight by 12% and 7% respectively. Results further revealed that prevalence of wasting in the sample was much higher than national and global figures. Improving food availability as well as accessibility and proper utilization methods were seen to be necessary conditions to improve the nutritional status in the area. This study revealed that prevalence of stunting, wasting and underweight is a considerable problem in low-income families in Colombo. It highlights the importance of implementing food and nutrition policies backed by food support and awareness programmes customized and oriented for local needs to overcome child malnutrition particularly among the urban low-income households.

**Keywords:** *Children, Low-income, Malnutrition, Stunting, Urban*

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**ABSTRACTS OF FLASH PRESENTATIONS**



## Serum Lipid Levels and Body Fat Percentages of Undergraduates in Rajarata University of Sri Lanka

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Sedentary lifestyles and unhealthy dietary habits are common among undergraduates, which are risk factors for cardiovascular diseases (CVDs). The prevalence of dyslipidaemia among this population is not known. This study was conducted to assess the prevalence of dyslipidaemia among undergraduates of Rajarata University of Sri Lanka (RUSL) and to determine the correlation between serum lipid levels and total body fat percentage (TBF%). In this descriptive cross-sectional study, undergraduates of RUSL were selected using simple random sampling. Their TBF% was measured using 8-electrode bio-impedance analyzer (HBF-375: Karada scan, Omron, Kyoto, Japan) and serum lipids were quantified using enzymatic colorimetry (BIOLABO-France) and classified according to Adult Treatment Panel-III guidelines by National Cholesterol Education Program (NCEP). Data were analyzed using beta-version of SPSS statistical analysis software. Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine & Allied Sciences, RUSL (ERC/2016/10) and written consent was obtained from the participants. A total of 130 students were recruited and 88 (68%) of them were females. Their mean age was 23 years ( $\pm 1$ ) and the mean TBF percentage was  $29.3 \pm 4.7\%$  in females and  $19.1 \pm 5.6\%$  in males. Mean serum total-cholesterol (TC), triacylglycerol (TAG) and low-density lipoprotein cholesterol (LDL-C) were  $172.8 \pm 29.6$ ,  $55.4 \pm 28$  and  $121.5 \pm 30.8$ , respectively. Mean of high-density lipoprotein-cholesterol (HDL-C) was  $39.92 \pm 10.2$  in female and  $41.1 \pm 10.2$  in male students. Sixteen percent participants ( $n=21$ ) were found to have high TC ( $>200$  mg/dl), 13% ( $n=17$ ) had high LDL-C ( $>160$  mg/dl), and 72.3% ( $n=94$ ) had low HDL-C ( $<40$ mg/dl in males;  $<50$ mg/dl in females). Furthermore, 46.9% were at risk of cardiovascular diseases based on LDL-C/HDL-C ratio. Total body fat percentage showed statistically significant correlations with HDL-C ( $r = -0.201$ ,  $p < 0.05$ ) and TAG ( $r = 0.210$ ,  $p < 0.05$ ) while no statistically significant correlation showed with TC and LDL-C levels. Present study exhibited a prevalence of 16% with hypercholesterolemia with no hypertriglyceridemia, while nearly half of the undergraduates of RUSL were at risk for cardiovascular diseases based on their lipid levels. Their TBF percentage had significant correlations only with HDL-C (negative) and TAG (positive) among serum lipid parameters.

**Keywords:** *Body fat percentage, Cardiovascular diseases, Serum lipid, Undergraduates.*

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## Study of Dominant Fungal Genera and Heat Resistant Spores in Pasteurized Mixed Syrup

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Pasteurized mixed fruit syrups are concentrated aqueous solutions of fruits and sugar. These syrups are used as ingredients to produce functional beverages mainly as a flavouring agent while enhancing the nutritional value due to the high content of phytochemicals and micronutrients. Although they are pasteurized, there is a possibility of growing mesophilic fungi and/or heat resistant fungi due to inadequate thermal processing, heat resistant structures or post-pasteurization contamination. In the present study, a commercial pasteurized fruit syrup; mixed berry syrup samples (strawberry, raspberry, blueberry and carrot) were tested for the presence of mesophilic and heat-resistant fungi to identify the common spoilage micro flora related to commercial pasteurized fruit syrups to improve the microbial quality of the product. A total of six samples were tested for mesophilic fungi using the spread plate method on Yeast Extract Glucose Chloramphenicol Agar at 20°C up to 5 days. The same samples were tested for heat resistant fungi using pour plate method on Malt Extract Agar according to the International Federation of Fruit Juice Producers (IFU) method No. 4 – Heat Resistant Mould Spore Detection, at 30 °C up to 6 – 15 days. Pure cultures obtained from both procedures were identified based on the colony morphology and the microscopic characteristics. Seven different fungal species were identified as mesophilic fungi and out of seven, four fungal species belonged to the genus of *Aspergillus* and the rest belonged to the genus *Penicillium*. Of ten species isolated from “Heat Resistant Moulds Spore Detection” procedure, six were identified as the species belonging to the genus *Aspergillus* and the rest belonging to the genus *Penicillium* with 60 and 40%, respectively. As a whole, the genus *Aspergillus* and genus *Penicillium* were identified as the dominant fungal genera in pasteurized mixed berry syrup samples tested in this study.

**Keywords:** *Aspergillus*, heat resistant fungi, mesophilic fungi, pasteurized mixed berry syrups, *Penicillium*.

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## Nutritional Status among Drug Addicts in Selected Rehabilitation Centres in Sri Lanka

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Illicit drug use has a heavy influence on the nutritional status of drug users. Many drug addicts neglect their nourishment as food and drugs may compete for the same brain reward sites. Furthermore, drug use leads to a high metabolic rate causing deterioration of their nutritional status. This study was conducted to assess the nutritional status among male drug addicts admitted to selected rehabilitation centres in Sri Lanka. As a part of a larger cross-sectional study, the nutritional status was assessed among 431 male drug addicts in five rehabilitation centres in Sri Lanka. Data were collected using an interviewer administered questionnaire. Weight and height were measured using standard methods and Body Mass Index (BMI) was calculated. A significant weight loss was defined as 'the loss of more than 5% of usual body weight over 6 to 12 months'. Data were analyzed using SPSS statistical software. Chi-square test was used to identify significant associations with weight loss following drug use at 0.05 significance level. Ethical approval was obtained from Ethics Review Committee, Faculty of Medicine, University of Ruhuna. Of total sample, majority were Sinhalese (n=355, 82.4%) with mean age (SD) of 32 (10.3) years. The mean BMI of the sample was 20.1±3.2 kg/m<sup>2</sup>. Nearly half of drug users (n=214, 49.7%) had normal BMI (18.5 kg/m<sup>2</sup> - 22.9 kg/m<sup>2</sup>). However, just over 1/3 of the sample was undernourished (BMI <18.5 kg/m<sup>2</sup>). A significant weight loss was identified among 58.0% (n=250) of the drug users. No statistically significant associations were found between significant weight loss and duration of drug use, poly drug use or problematic drug use. Moreover, being undernourished was not associated with the age, place of residence, monthly income and occupation. A significant weight loss and being undernourished were identified as a problem among drug users irrespective of their drug use and socio-demographic status. Proper nutritional interventions are recommended to improve nutritional status among drug addicts.

**Keywords:** Drug addicts, illicit drug use, nutritional status, rehabilitation, weight loss

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## The Effect of Processing on Antioxidant Activity of Sorghum Cultivars Grown in Sri Lanka

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Sorghum is mainly used as an animal feed in developed countries, however, it is the staple in many developing countries. However, in Sri Lanka, sorghum remains as an underutilized cereal. Sorghum is reported to possess a variety of health-protective properties. Therefore the objectives of the present study was to investigate the impact of processing on the antioxidant activity of two sorghum cultivars grown in Sri Lanka. Seed samples of sweet sorghum and ICSV-112 cultivars were collected from the Field Crop Research and Development Institute, Mahailuppallama. The antioxidant activity of water and methanolic extracts of raw and processed (boiled, microwaved, and oven-roasted) whole seed samples was assessed by three different standard methods. Total phenolic content (TPC) and the total flavonoid content (TFC) were also estimated using standard methods. The statistical analysis was performed by ANOVA (SPSS 20). Compared to the raw (control) sample, the DPPH scavenging activity, NO scavenging activity and FRAP for water and methanol extract of both cultivars were observed as follows: oven-roasted > microwaved > boiled. TPC and TFC estimations also showed similar pattern. Interestingly, some extracts of both cultivars showed significantly ( $P < 0.001$ ) higher antioxidant activity compared to raw sample, including DPPH scavenging activity in both methanolic and water extracts, NO scavenging activity for methanolic extract, FRAP activity for both methanolic and water extracts and TPC in methanolic extract. Compared to ICSV-112 cultivar, sweet sorghum showed a higher DPPH scavenging activity, FRAP activity and TPC and TFC. However, ICSV-112 had comparatively higher NO scavenging activity compared to sweet sorghum. The results of the present study indicate that both sorghum cultivars grown in Sri Lanka are rich in anti-oxidants and their consumption can be promoted as functional foods. Oven-roasted method can be recommend as the best processing method which preserve the highest anti-oxidant activity of sorghum seeds.

**Keywords:** Antioxidant activity, Food processing, Sorghum

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## Perceived Barriers and Facilitators of Healthy Eating in Rural and Peri-urban Communities in Sri Lanka

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Identification of healthy eating behaviours and barriers is a key to tackle the nutrition issues in the rural communities. A qualitative descriptive study was carried out to investigate food gatekeepers' barriers and facilitators in consuming healthy family meals in rural communities. Eight (n=8) focus group discussions (two from each district) were conducted among adult women (n=70) from different ethnic groups (age 19-45) who were selected from Batticaloa, Ampara, Trincomalee and Polonnaruwa districts. The recorded focus group discussions were transcribed and later translated into English. Data were analyzed thematically using N-vivo 12 software as a collective decision of the participants. Five major themes were identified: perceptions of a healthy diet, healthy/nutritious food, barriers for a healthy diet, strategy to make family meals healthy; nutritional values of foods; nutrition-related issues; perceived determinants of nutrition issues; and sources of nutrition information. Almost all participants had a clear picture about a healthy diet. Most of the food groups were included in their daily meal. They perceived that the busy life-style, poverty, ignorance, high cost of healthy foods and seasonality of some healthy foods as the barriers to have a healthy diet. Consumption of raw form of leafy vegetables, the use of clean utensils to prepare foods (clay pots) and eating slightly cooked leafy vegetables were the strategies used to make family meals healthy. Although participants suffer from malnutrition, they do not think nutrition issues have come to the level of malnutrition. Participants said that the less consumption of nutritious food was the major reason for nutritional issues. Midwife was the main source of nutritional information. People were willing to engage in home gardening and consuming locally available foods. Findings indicate that food literacy related to knowledge domain is adequate. However, applying knowledge into practice has several barriers. There were knowledge gaps on prevailing nutrition issues in the community. Therefore, government and relevant stakeholders should take necessary actions to change behaviour on healthy eating.

**Keywords:** *Barriers, Facilitators, Healthy diet, Nutrition issues, Rural communities*

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## Evaluation of Heat Resistance of *Aspergillus chevalieri* Isolated from Pasteurized Mixed Berry syrup

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Heat resistant fungi have been identified as spoilage organisms in processed fruit juices, nectar, pulps and fruit syrups. These organisms can withstand the pasteurization temperatures due to the formation of characteristic heat resistant structures such as thick walled-sexual spores (ascospores). In the present study, spoilage fungal species from pasteurized mixed berry syrup (pasteurization conditions- 95 °C for 4 minutes) were isolated on Malt Extract Agar at 30 °C and identified by amplifying the ITS Ribosomal RNA gene region. One fungi identified was *Aspergillus chevalieri* of which the teleomorph has been detected as a heat resistant xerophilic fungi. Due to that reason, the heat resistance characteristics of *A. chevalieri* were detected at 95 °C (pasteurization temperature used in the industry) at different time intervals to plot a D - graph. Pasteurized mixed berry syrup was used as the heating medium. *Aspergillus chevalieri* was grown on MEA at 30 °C for 30 days to ensure the production of ascospores which were detected by microscopic examination. Sterile mixed berry syrup (60 ml) was inoculated with mycelium plugs containing ascospores of *A. chevalieri* and incubated for 30 days at 30 °C. The initial colony count was obtained as 20 CFU/ml by plating decimal dilutions of inoculated sterile mixed berry syrup in MEA at 30 °C up to 6-15 days. The heat treatment was given for each 10 ml of the sample for time intervals of 1, 2, 4, 6 and 7 min at 95 °C in a shaking water bath. After each time interval, the relevant test tube was cooled. Decimal dilutions were prepared and plated on MEA and incubated at 30 °C up to 6-15 days. None of the plates exhibited any microbial growth. This concludes that *A. chevalieri* is destroyed by the given heat treatment combinations.

**Keywords:** *Ascospores, Aspergillus chevalieri, heat resistant characteristics, mixed berry syrup, pasteurization*

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## Quantification of Sodium Content in Commonly Consumed Foods and beverages in Sri Lanka

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The World Health Organization (WHO) recommends reducing sodium consumption to less than 2 g per day as diets high in sodium lead to non-communicable diseases. Therefore, WHO Member States agreed to reduce salt intake by 30% by 2025. Due to lack of data on sodium content of foods consumed in Sri Lanka, it is important to quantify sodium content of foods to formulate recommendations for sodium intake. Hence, randomly collected food samples were categorized according to WHO Nutrient Profile Model for SEAR. Sodium content of confectionary (CON, n=37), cereals (CER, n=10), fine bakery ware (FBW, n=42), bread and ordinary bakery ware (BO, n=30), water-based flavoured drink (BEVC, n=8), cereal, grain, tree nut based beverages (BEVE, n=5), frozen dairy based desserts and edible ices (FDD, n=7), curried dairy based desserts (CDD, n=19), composite foods (CPF, n=8), pasta, noodles and like products (PNO, n=4) and sauces, dips and dressing (DRE, n=3) were analysed using flame photometer (Model 420, Sherwood Scientific) after dry-ashing. The range of sodium content (mg/100g  $\pm$  SD) of CON, CER, FBW, BOB, BEVC, BEVE, FDD, CDD, CPF, PNO, DRE were 0-269  $\pm$  6, 8 $\pm$ 1 - 291 $\pm$ 10, 43 $\pm$ 1 - 1613 $\pm$ 29, 5 $\pm$ 0 - 867 $\pm$ 37, 7 $\pm$ 0 - 156 $\pm$ 3, 0 - 158  $\pm$  15, ND - 158 $\pm$ 15, 32 $\pm$ 1 - 158 $\pm$ 15, 233 $\pm$ 2 - 525 $\pm$ 14, 4 $\pm$ 0 - 427 $\pm$ 13 and 3 $\pm$ 0 - 1442 $\pm$ 10, respectively. For categories of FDD and CDD, BEVE, FBW, BOB and PNO, CER and CPF, BEVC and DRE, the threshold limits for sodium given in the model were 100, 200, 250, 350 and 300 mg/100g, respectively, although for CON the threshold limit is not specified. Among tested samples, percentage prohibited from each category according to the thresholds was for CER, BEVC and BEVE - 0%, CDD - 16%, FDD - 29%, DRE - 33%, BOB and PNO - 50%, FBW - 55% and CPF - 67%. Therefore, it is important to implement recommendations in marketing of food and beverages to children and to aware manufacturers to reformulate food products based on threshold limits for sodium provided in the model.

**Keywords:** Flame Photometer, Foods, Beverages, Sodium Content

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## Dietary Intake and Dietary Behaviour of Shift Working Female Nurses

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Shift working nurses are known to have unhealthy dietary behaviours including increased energy and macronutrient intakes, unhealthy snacking, meal skipping and low physical activity due to the nature of their work schedule. The objective of the study was to compare dietary intake and dietary behaviour of female nurses during day and night shift days. One hundred nursing staff working on shift basis (including a day and night shift) were recruited to the study. Health and lifestyle questionnaire was used to assess lifestyle factors. Nutritional status was assessed using anthropometric measurements. Food frequency questionnaire was used to assess the dietary behaviours. Four 24-hour dietary recalls covering two day-shifts and two night-shifts were used to assess nutrient intake. Physical activity level was assessed using the International Physical Activity Questionnaire. Majority of the nurses had body mass index (BMI), waist circumference and waist to hip ratio in the 'risk' category. Takeaway meals were rarely consumed and 55% of the nurses skipped meals. The mean daily intakes were significantly ( $P < 0.005$ ) higher in energy, protein, carbohydrate, fat and cholesterol during the days with night-shift compared to the days with day-shift [(Energy 1495 kcal vs 1286 kcal), (Protein 45 g vs 39 g), (Carbohydrate 240 g vs 204 g), (Fat 46 g vs 40 g), (Cholesterol 143 mg vs 100 mg)]. The nurses in the present study had unhealthy dietary intakes (increased intake of macronutrient and lower intakes of vitamins, minerals and PUFAs) and dietary behaviour patterns, similar to patterns seen in shift workers globally.

**Keywords:** *Dietary intake, Female, Nurses, Nutritional status, Shift work*

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## **Anthropometric, Dietary, Clinical, Lifestyle and Psychosocial Characteristics of Obese Adults Attending a Weight Management Programme**

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Epidemiological studies worldwide indicate that the prevalence of obesity is increasing and currently it is the most common metabolic disease in the world. High prevalence of overweight and obesity has been reported in Sri Lanka. Assessment of anthropometric, dietary, clinical, socio-demographic, lifestyle and psychosocial characteristics of obese individuals are necessary in an effective personalized therapy for them. The objective of the study was to investigate baseline anthropometric, socio-demographic, clinical, food and behavioral patterns of obese men and women attended in a weight management programme. The study was conducted in private hospital settings in Colombo recruiting 100 obese adults (BMI >25 kgm<sup>-2</sup>) of both males (n=34) and females age between 20 - 50 years, at the screening of a weight management programme. A pretested health and lifestyle questionnaire, general wellbeing scale (GWBS), International Physical Activity Questionnaire (IPAQ) – long form and a semi quantitative food frequency questionnaire (FFQ) were used to collect information. Majority of the study population (66%) was belonged to the obesity class II (BM ≥ 30 kg<sup>-2</sup>). Prevalence of central obesity was 99% and 52% of the subjects had metabolic syndrome. Only 19% of them were in positive wellbeing according to GWBS. Sixty seven percent of the participants had low physical activity level. Obese subjects had several unfavorable food habits. Although the proportion of energy contributed from carbohydrates, protein and fat were within the recommended level, intake of total energy and energy from saturated fatty acids were higher than the recommendation. Fibre and Vitamin D intakes were below the Recommended Dietary Allowance (RDA) and intakes of sodium and potassium were higher than RDA. They consumed lower fruit and vegetable and higher cereal compared to the recommendations given in the food-based dietary guidelines. In conclusion, obese subjects had poor dietary and lifestyle patterns, low physical activity level, poor general wellbeing and considerably high prevalence of metabolic syndrome and associated disorders.

**Keywords:** *Dietary pattern, general wellbeing, metabolic syndrome, obese adults, physical activity*

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## Feeding Practices During the First Eighteen Months of Life

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Inappropriate feeding practices during early life are the main causes of child malnutrition. The objective of this study was to determine the feeding practices of children 12 - 18 months of age and their association with growth faltering. A cross-sectional descriptive study was conducted among 254 children aged 12 and 18 months attending an immunization clinic of a tertiary hospital. Feeding practices were assessed using interviewer-administered questionnaire. Weight and length were measured using standard methods. Data on past growth were extracted from the Child Health Development Record. There were 44.5% (n=113) girls, and 53.1% (n=135) were 12-month-olds. 20.7% (n=28) of the 12 month-olds and 14.3% (n=17) of the 18 month-olds had weight-for-length <-2SD. Exclusive breastfeeding was given at least 4 months to 87.8% (n=223) and at least 6 months to 60.2% (n=153). 91.9% (n=124) of the 12 month-olds were still breastfed. Of them, 41.9% (n=52) were breastfed on-demand (<-1SD; p=0.06) and 42.7% (n=53) were given several feeds during the night (<-1SD; p=0.09) therefore these practices were not significantly associated with nutritional status. 84% (n=100) of the 18 month-olds were still breastfed. Of them, 43% (n=43) were still breastfed on-demand and this was not significantly associated with nutritional status. Several night feeds were given to 51.2% (n=61) of the 18 month-olds and this was significantly associated with weight-for-age <-2SD (p=0.04) and weight-for-length <-2SD (p=0.006). 32.6% (n=44) of the 12 month-olds and 25.2% (n=30) 18 month-olds were on formula feeds which showed no association with the nutritional status. Introduction of foods of animal origin were delayed. Eggs, fish and meat were not given till 8 months to 44.8% (n=114), 32.7% (n=83) and 68.9% (n=175), respectively. Inappropriate feeding practices are prevalent in this population with high prevalence of growth faltering at 18 months of age.

**Keywords:** *Children, feeding practices, growth faltering*

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## Perception of Consumers on the ColorCoding System for Beverages

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Consumption of excessive sugar is one of the factors contributing to overweight, obesity, and non-communicable diseases such as type 2 diabetes and cancer. In spite of the negative health implications, the consumption of sugar-sweetened beverages is on the rise and sugar serves as one of the major sources of calories especially among children. The government of Sri Lanka introduced a colour coding system, commonly termed 'traffic light system', for carbonated beverages, ready to serve drinks, nectars and fruit juices in August 2016. However, the awareness of consumers on the colour coding system its impact on the purchase decision have not been studied. In this context, the current study aimed at determining the awareness of consumers on the colour coding system and its impact on the purchase decision of the consumers. The study was carried out in Negombo, Sri Lanka in 2017. Data collected from 210 randomly selected participants using an interviewer-administered questionnaire were analyzed. The results indicated that majority of the participants (64%) were concerned about the level of sugar they consumed. Approximately 79% of respondents were aware of the new labelling system implemented in Sri Lanka and they checked the colour code at the time of purchase. A significant proportion of the respondents (73%) preferred low or medium sugar levels in the drinks. Many respondents mentioned that they would like to have the same system implemented for other foods as well.

**Keywords:** *Colour coding system, Food act, Sugar, Sugar-sweetened beverages, traffic light system.*

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## Trans Fatty Acid Content of Shortenings and Fat Spreads Used in the Bakery Industry in Sri Lanka

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Shortenings and fat spreads are major ingredients used in bakery products thus make a significant influence on the fat level and the fatty acid (FA) content of the final product. Due to usage of partially hydrogenated vegetable oils in the production process, shortenings and fat spreads are one of the important sources of *trans* fatty acids (TFA). Since there is no reliable data available on the TFA of shortenings and fat spreads sold in Sri Lanka, there is an immense need of determining the TFA of them. These data will be important for the policy makers, food manufacturers and consumers. The purpose of this study was to quantify TFA content and determine the fatty acid profile of shortenings and fat spreads used in the bakery industry in Sri Lanka. Nine brands of shortenings and fat spreads (coded A-I) were collected from 4 districts namely Colombo, Kandy, Galle and Anuradhapura. The FA composition and the TFA content were determined by gas liquid chromatography (GLC). Among the tested shortenings and fat spreads, the saturated FA (SFA) content ranged from 13.1% to 52.1% of total FA while the monounsaturated FA (MUFA) and polyunsaturated FA (PUFA) contents were 0.5-31.8% and 0.7-31.6% of total FA respectively. Among the SFA, palmitic acid (C16:0) (17.5-40%) and lauric acid (C12:0) (13.9-14.3%) were dominant and their higher amounts indicated a significant contribution of palm and coconut or palm kernel oils in the manufacture of shortenings and fat spreads. The content of TFA ranged from 0.3% to 2.1% of total FA. *Trans* C18:1 isomer was the major group of TFA present in analysed samples, representing 72.7-100% of total TFA. The content of C18:2 *trans* isomer ranged from 0.0% to 0.4% of total FA. These findings suggest that FA composition of shortenings and fat spreads used in the bakery industry in Sri Lanka should be improved by replacing TFA and SFA with beneficial ones, in order to avoid adverse effects on health. Therefore, legislative changes and consumer information are urgently needed.

**Keywords:** Gas liquid chromatography, polyunsaturated fatty acids, shortenings, trans fatty acids.

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## **Analysis of the Physicochemical and Sensory Properties of the Most Commercially Available Yoghurt and Curd Products in the Market and Determination of Formalin Content in Curd**

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Yoghurt and curd are very popular among Sri Lankan consumers. There are no mandatory product regulations in Sri Lanka for yoghurt and curd, and a wider variation exists among products available in the market in terms of quality. Hence this study will be important to policy makers, nutritionists and food manufacturers. This study was conducted to evaluate physicochemical and sensory properties of selected yoghurt and curd brands. Furthermore, formalin content in selected curd brands was also analysed qualitatively to determine the possible adulteration. Most commercially available yoghurt brands (YA, YB, YC, YD & YE) and curd brands (CA, CB & CC) were identified through a market survey. Physicochemical properties (milk solid non-fat, titratable acidity, moisture content, fat content, protein content, pH and colour) were analysed according to AOAC methods and SLS No: 824 standards. Sensory properties were evaluated using a nine-point hedonic test. Data were statistically analysed using ANOVA, SAS 9.0. Significant differences ( $p < 0.05$ ) in physicochemical properties were observed among yoghurt brands. Maximum fat content of 4.27% (w/w) was observed in YC yoghurt brand. Physicochemical properties except moisture content and protein of the curd brands showed significant differences ( $p < 0.05$ ). Maximum fat content of 7.29% (w/w) was observed in CA curd brand and the maximum protein content of 4.86% (w/w) was observed in CC curd brand. Significant differences ( $p < 0.05$ ) in mean scores of sensory properties were observed among yoghurt and curd brands analysed separately. All the curd brands exhibited negative results for the presence of formalin. In conclusion, all tested yoghurt and curd brands were in acceptable quality and YD yoghurt brand and CB curd brand had the highest consumer acceptability. However, it is recommended to have mandatory product regulations for yoghurt and curd to maintain the uniformity among the brands and to assure better quality.

**Keywords:** *Curd, Formalin, Physico-Chemical Properties, Sensory Properties, Yoghurt*

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## Photocatalytic Degradation of Bisphenol-a and Ciprofloxacin in Drinking Water Using Graphene-Based Photocatalyst

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The toxicity of micro pollutants, Bisphenol-a (BPA), and ciprofloxacin antibiotic present in drinking water is a global food safety issue. Photocatalysis is one of the effective methods to remove micro pollutants from water. During recycling of plastic material, BPA can leach into drinking water. Similarly, excessive use of antibiotics in animal husbandry, drug residues are added to water. The objective of the study was to determine the effectiveness of the graphene-based photocatalytic material in removing BPA and ciprofloxacin antibiotic residues in drinking water. Photocatalytic material with different concentrations (0.8, 1.0, 2.0 g/L) was added to BPA or ciprofloxacin solution with 10 mg/L initial concentration, mixed to ensure even dispersion of material, and the beaker contained the solution was exposed to a halogen light (Lux 860-890). The absorbance of the BPA and Ciprofloxacin solution samples at different time intervals was measured by UV-VIS-NIR Spectrophotometer at 276 nm and 274 nm, respectively. Degradation behaviour was studied by changing pH, initial concentration of BPA and ciprofloxacin, photocatalyst concentration, and light source. The highest degradation efficiency for BPA was achieved with 2.0 g/L catalyst concentration (95.5±0.20%), 10 mg/L initial BPA concentration (95.70±0.73%), pH 8.2 (92.60±2.85%), and under visible range which is, 380 nm to 750 nm (95.7±0.73%). Ciprofloxacin degradation was effective at 1.0 g/L catalyst concentration (98.13±0.12%), with halogen light (97.56±0.12%), and sunlight (96.38±0.19%). Degradation of BPA with time showed a linear relationship under UV light and pH conditions 5.4, 7.3, and 8.2 giving a squared correlation as 0.9523, 0.9797, 0.9515, and 0.9358, respectively. However, ciprofloxacin degradation did not exhibit a linear relationship with time. It was clear that degradation of BPA does not follow first order kinetics when resulting in the higher degradation efficiencies. BPA and Ciprofloxacin degradation was in the range of 92-99% with the photocatalyst. It can be concluded that graphene-based photocatalyst developed in this study is a possible nano compound to degrade harmful BPA and ciprofloxacin present in drinking water sources.

**Keywords:** Bisphenol-A (BPA), Ciprofloxacin, drinking water, graphene-based photocatalyst

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## Use of Cyclodextrin to Remove Cholesterol in Milk and its Effect on the Availability of other Milk Constituents

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A strong positive correlation exists between serum cholesterol level and development of coronary heart diseases. Serum cholesterol level is affected by dietary cholesterol level. Due to this, people are concerned about the excess cholesterol intake through food. The use of  $\beta$ -cyclodextrin to remove cholesterol from milk is a successful, well-tested method in dairy industry among many ineffective methods. However, it can affect the availability of other milk constituents. The purpose of this study was to assess the effectiveness of  $\beta$ -cyclodextrin to remove cholesterol from milk under different conditions such as cyclodextrin percentage, pasteurized milk with and without homogenization, mixing time and centrifugal force and to assess the effect of cholesterol removal process on the availability of other milk constituents (lactose, fat, solid non-fat, protein and salts). For this purpose, different levels of  $\beta$ -cyclodextrin were added to milk, stirred and the mixture was centrifuged. Upper and middle layers were analyzed separately. Lieberman-Burchard method was used to quantify cholesterol and Lactoscan milk analyzer was used to quantify the other milk constituents. Maximum removal of cholesterol from pasteurized milk with homogenization and without homogenization was achieved at 2% and 1.5% cyclodextrin percentages, respectively. With 1.5% cyclodextrin, 51.3% and 55.9% cholesterol reduction was resulted in upper and middle layers of pasteurized milk with homogenization, respectively. Five-minute mixing of cyclodextrin (2%) and at 2000 rpm centrifugation provided the maximum removal of cholesterol from pasteurized milk without homogenization. It provided 67.3% and 70.7% cholesterol reduction in upper and middle layers respectively. Levels of main milk constituents were affected by the cholesterol removal process and the effect was different depending on the constituent and the condition (cyclodextrin percentage, homogenization, mixing time and centrifugal force). Based on the results of this study it can be concluded that  $\beta$ -cyclodextrin can be used effectively to remove cholesterol from dairy products. But depending on the processing conditions, percentages of fat, salt, lactose, protein and solid non-fat present in milk can be significantly affected.

**Keywords:**  *$\beta$ -Cyclodextrin, cholesterol, complex formation, milk constituents*

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## Association of Household Food Security Status with Central Obesity among the Early Adolescents in Colombo, Sri Lanka

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The upward trend of prevalence of high rate of overnutrition among grade 7 (11-13 years) school children was reported in Colombo. Studies conducted to find out the association between household food security status and overnutrition is lacking. Hence, this study was carried out to determine the association of household food security status with central obesity in early adolescents aged 11-13 years in Colombo. This cross-sectional study was carried out in 12 randomly selected national and provincial schools in Colombo. A proportionate sample of 634 subjects was recruited using multistage stratified cluster sampling technique. Household food security status was determined using United States Department of Agriculture food security module. Waist circumference and standing height were measured and waist to height ratio was calculated. Daily energy intake was assessed using a three day diet diary and level of physical activity was measured using PAQ-C questionnaire. The association between household food security score and waist to height ratio was analyzed using partial correlation, after adjusting for confounders. The prevalence of food security among boys and girls were 34.3% and 26.5% respectively. The prevalence of food insecurity among boys was 18.5% and among girls was 20.6%. Boys showed a negative weak ( $r = - 0.152$ ;  $P < 0.05$ ) association between household food security score and waist to height ratio and association was insignificant ( $P > 0.05$ ) after adjusting for confounders of daily energy consumption, level of physical activity, pubertal stage, birth weight and age. Household food security score was not associated with waist to height ratio of girls ( $P > 0.05$ ) and an inverse association ( $r = - 0.373$ ) was appeared ( $P < 0.05$ ), after controlling for confounders. Thus, household food security is positively associated with central obesity in 11 – 13 year girls in Colombo.

**Keywords:** *Central obesity, early adolescents, household food security*

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## Natural Plants with Antioxidant Properties; A Possible Treatment for Diabetes Mellitus

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Natural products that are included in the diet of Sri Lankans have significant antioxidant properties which have not been identified to date. Sri Lankans faith in food sources and Ayurvedic decoctions contain anti-diabetic properties and these may be beneficial in the dietary management of diabetes mellitus in the early stage. Plants with potential antioxidant properties are important in this regard. This study is focused on determination of antioxidant properties of five plants (aqueous crude extracts prepared by maceration) which include *Cassia fistula* (Ehela) bark, *Eleusinecoracana* (Kurakkan) seed, *Lasia spinosa* (Kohila) Rhizome, *Spondiasdulcis* (Ambarella) ark and *Ficusracemosa* (Attikka) fruit. The plants were selected after an overview on the use of them by Ayurvedic practitioners in the treatment of diabetes mellitus. The *in vitro* antioxidant potential was evaluated using 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay using the spectrophotometric method using ascorbic acid as the standard. The DPPH radical scavenging activity was expressed in terms of IC<sub>50</sub> value. Furthermore, a preliminary phytochemical analysis was conducted on the selected plants freeze dried extracts. The IC<sub>50</sub> values were *Cassia fistula* (0.074±0.003 mg/mL), *Eleusinecoracana* (0.085±0.004 mg/mL), *Lasia spinosa* (0.092±0.000 mg/mL), *Spondiasdulcis* (0.094±0.001 mg/mL), *Ficusracemosa* (0.104±0.002 mg/mL). All the extracts showed a significant correlation (P value <0.05) with the standard ascorbic acid. Furthermore, in phytochemical analysis, phenolic compounds such as tannins, alkaloids, and flavonoids were identified in the plant extracts. The highest antioxidant potential in terms of IC<sub>50</sub> was observed in *Cassia fistula* bark extract and the lowest antioxidant potential was observed in *Ficus racemose* fruit extract. In the phytochemical analysis, the plants with antioxidant properties showed presence of flavonoids and tannins. Therefore, these compounds might attribute for the potential antioxidant properties of the plants. In conclusion, all these plants show potential antioxidant properties.

**Keywords:** Antioxidant activity, Ayurvedic medicine, *C.Fistula*, *E.Corcana*, *L.spinosa*, *S.dulcis*

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## **Antifungal Efficacy of Amla (*Phyllanthus emblica*) and Lime (*Citrus aurantifolia*) against *Candida albicans*.**

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Amla (*Phyllanthus emblica*) and lime (*Citrus aurantifolia*) are commonly consumed fruits known to be rich in many nutrients. Even though they are consumed as fruits, the medicinal value and the therapeutic potential of them have not been investigated scientifically. They have also been used extensively in Ayurvedic preparations to treat diverse infectious diseases since ancient times. The study was conducted to determine the antifungal activity of aqueous fruit extract of *P. emblica* and *C. aurantifolia* against *C. albicans* (ATCC 10231) using both agar well diffusion and broth microdilution methods. The minimum fungicidal concentration (MFC) of the extracts was determined after incubating for 48 h at 37 °C. Relative percentage inhibition was determined using Nystatin (100 mg/mL) as the positive control. In the well diffusion assay, 500 mg/mL concentration of *P. emblica* showed an activity of 59.7% and 56.3% in 24 h and 48 h, respectively against Nystatin. 250 mg/mL *P. emblica* showed an activity of 47.2% and 47.9% in 24 h and 48 h, respectively against Nystatin. Minimum fungicidal concentration of *P. emblica* was observed at 250 mg/mL. Antifungal effect of *C. aurantifolia* could not be identified even at a concentration of 500 mg/mL. *P. emblica* aqueous extract revealed the presence of cardiac glycosides, flavonoids, and tannins, while *C. aurantifolia* revealed the presence of flavonoids and carbohydrates in the aqueous extract upon preliminary phytochemical screening. This study shows that the aqueous extract of *P. emblica* possesses antifungal properties, and is effective against *C. albicans*. Thus, incorporation of *P. emblica* in the diet may aid to prevent *Candida* associated infections in an individual. *P. emblica* extract can also be used for the development of novel antifungal formulations against *C. albicans*.

Financial assistance by Kaatsu International University (KIU) for research is acknowledged.

**Keywords:** Antifungal, *Candida albicans*, *Citrus aurantifolia*, *Phyllanthus emblica*

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## Household Food Security, Food Consumption Behaviour and Food Safety during the COVID-19 Pandemic and Lockdown Period During Early 2020 in Sri Lanka

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C.J. Wijesinghe<sup>3</sup> and T. Joshepkumar<sup>4</sup>

COVID-19 pandemic has created a significant impact on human lifestyle. Objectives of the present study were to identify the level of household food security, changes in dietary patterns, food purchasing behaviour and food safety practices adopted by Sri Lankans during the lockdown period of March-April, 2020. Ethical approval for the study was obtained from the Ethical Review Committee, Faculty of Medicine, University of Ruhuna. An online survey was conducted among Sri Lankan adults via email and social media network. Data were presented as numbers and percentages. Median (min-max) age of the participants was 27 (19-77) years and they were from 19 districts. Among the total of 260 participants, 205 (78.9%) were uncertain on food supply which mainly attributed to difficulty in purchasing due to the overcrowding and long queues 117 (57.0%) and unavailability of the food in the market 107/205 (52.1%). Most of them had consumed the same type of diet frequently while majority had not experienced missing meals and fasting at all. Main modes of access to food during the period were visiting nearby shops (206) and purchasing from door-to-door sellers (159). Majority had washed fruits and vegetables with clean running water before storage without using soap, detergents, bleach or any other cleaners or sanitizers. Furthermore, it was revealed that none of them had kept fruits or in the sun before storage. They had destroyed the food packages and had avoided sharing the food and utensils but, had not avoided consuming half-boiled eggs, omelette or bulls-eye eggs. Many had consumed home grown produce. Consumption of starchy foods, coriander seed and ginger extracts, Kola Kanda/other forms of Kanji and herbal preparations had increased while consumption of fruits, meat, fish, sweetmeats, surgery beverages, ice cream, yoghurt and cool drinks had decreased. Food insecurity and uncertainty of food supply is common among people during lockdown period. Food purchasing, consumption patterns and food safety related behaviours are in line with the COVID-19 related health guidelines.

**Keywords:** COVID-19, dietary habits, food safety, food security, lockdown period.

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## **Adherence to 5-a-Day Fruit and Vegetable Recommendations and Association with Blood Pressure in Adults**

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Numerous studies support the protective effect of high fruit and vegetable (FV) consumption on chronic disease risk, mainly against hypertension. The World Health Organization (WHO) recommends an intake of a minimum of 400 g or five portions of FVs per day for the prevention of chronic diseases. This study aimed to determine the adherence to 5-a-day FV recommendations and associations with blood pressure among Sri Lankan adults. In a cross-sectional study, a total of 308 normotensive adults (125 men and 183 women) in the age range of 18-60 were recruited. A semi-quantitative food frequency questionnaire was used to determine the FV consumption. Height, weight, and blood pressure of the subjects were measured. Logistic regression analysis was performed to assess the risk associated with low FV intake on blood pressure. Mean (SD) age of the subjects was 40.4 (11.4) years. Mean (SD) intake of FVs was 385 (103) g. Mean (SD) consumption of fruits, vegetables and FVs together were 1.83 (0.75), 2.97 (0.97) and 4.80 (1.29) portions, respectively. Only 32% of the subjects consumed five or more portions of FVs whereas 68% of them had less than 5 portions per day. Low intake of recommended FV significantly increased risk of high systolic blood pressure (OR=10.7; 95% CI 1.4-80.9). In conclusion, intake of FV was below the current WHO recommendations whereas low intake of FV significantly increased the risk of high blood pressure. Public awareness on adequate consumption of FVs should be promoted targeting vulnerable population.

**Keywords:** *Blood pressure, diastolic, fruits and vegetables, portions, systolic*

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## Contribution of Sun Exposure and Vitamin D Supplementation to Serum 25(OH)D Concentration among Older Adults

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Cutaneous synthesis of vitamin D upon UVB exposure is considered as the main source of vitamin D. However, the relative contributions of cutaneous vitamin D synthesis and oral (supplements and food) vitamin D intake to serum 25(OH)D concentration are not well understood. The objectives of this study were to determine the effect of monthly supplemental vitamin D<sub>3</sub> for 12 months and sun exposure on serum 25(OH)D concentration among older adults. A total of 375 older adults (>70 years old) were recruited from North East of England and randomized to either 12000, 24000 or 48000 IU vitamin D<sub>3</sub> monthly for 12 months. Sun exposure habits of participants were determined using a questionnaire for five times during 12 months. Serum 25(OH)D concentration was measured by Liquid Chromatography Tandem Mass Spectrometry before and after the intervention. ANOVA and backward linear regression were used to examine the effect of vitamin D<sub>3</sub> supplementation on serum 25(OH)D concentration and to identify sun exposure habits predicting serum 25(OH)D concentration. After 12 months supplementation, 25(OH)D concentrations increased by 14.3±12.6, 25.3±SD 18.0 and 40.9±19.8 nmol/L who received 12000, 24000 and 48000 IU of vitamin D<sub>3</sub>, respectively (p<0.0001). In participants who received 12000 IU monthly, sun exposure duration, skin exposure area and female gender were positively associated with serum 25(OH)D concentration, while skin type IV, calcium intake and BMI were negatively associated with 25(OH)D concentrations. None of the sun exposure variables was significantly associated with 25(OH)D concentration for participants who received 24000 IU and 48000 IU of vitamin D<sub>3</sub>. In conclusion, vitamin D<sub>3</sub> supplementation for 12 months produced a significant dose-related increase in 25(OH)D concentration. Sun exposure variables predicted vitamin D status only in participants who received 12000 IU/month of vitamin D<sub>3</sub>. With higher doses of supplemental vitamin D<sub>3</sub> no significant effects of sun exposure habits on 25(OH)D concentration in older adults were detected.

**Keywords:** *Vitamin D supplementation, sun exposure, serum 25(OH)D concentration.*

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## The Prevalence of Disordered Eating and Menstrual Dysfunction among Female Athletes of Selected State Universities in Sri Lanka

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Female athletes are more prone to various medical conditions, sport injuries and other physical problem than male athletes. The main objective of the present study was to determine the prevalence of Eating Disorder (ED) and Menstrual Dysfunction (MD) among university female athletes in Sri Lanka. ED is commonly described as abnormal or disturbed eating behaviors. Anorexia and Bulimia Nervosa are the main two types of ED. MD is a physical and emotional problem that interferes with the normal menstrual cycle. This cross-sectional study carried out on a group of female athletes who participated at Sri Lanka University Games (SLUG) 2019 in 11 different sports. Three questionnaires of the Eating Attitude Test (EAT-26), behavior questionnaire and menstrual history questionnaire were circulated among through a Google form. All statistical analyses were performed with SPSS Version 21 software and Google spreadsheets. Participants were in the age range of 21-26 years. Of the responded 234 participants, ED was reported by 9.4% of the female athletes and 6.8% are classified as at risk of “Bulimia Nervosa”. Female athletes were having premenstrual syndrome (51%). Presence of irregular menstrual cycles was reported by 24% of the sample. Oligomenorrhea was the most frequently reported problem (8.9%), and polymenorrhea was less prevalent (3.8%). The results showed that there was no statistically significant relationship between ED and MD through the Chi-squared test ( $p > 0.05$ ). A considerable percentage of female athletes have menstrual irregularity than eating disorders. Therefore, screening and early identification and appropriate interventions are advisable.

**Keywords:** *Eating disorder, menstrual dysfunction, oligomenorrhea, polymenorrhea, premenstrual syndrome, university athletes.*

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## **A Study on Dietary Supplements Usage and Knowledge of Anti-Doping Practices among Karate Players in Northwestern Province in Sri Lanka**

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Dietary supplements and the use of illicit substances in sports have become popular among athletes. Knowledge about dietary supplements and anti-doping is the most important for all the sports men as it is important to stay away from using anti dopes. This study was focused on the karate players of North Western province in Sri Lanka as they emerged as the champions at the National Sports Festival 2019. To assess the level of using dietary-supplements and knowledge of anti-doping practices among karate players in North-Western province. The data were gathered using standard questionnaires consist with three main parts. The first, second and third parts were consisted with demographic information, data on dietary supplements and anti-doping respectively. From random sampling method, 129 players were selected for the sample and it represented 50% of provincial-level Karate players in 56 Karate Associations in the selected province. Microsoft Excel 2013 and Minitab version 18 were used to statistical analyzes. One-way Variance Analysis (ANOVA), was used to see the significant difference in the knowledge of Anti-Doping with respect to the level of participation of Karate players. In terms of results 100% were used dietary supplements in the sample. Vitamin C (91.6%), iron (78.5%) and multivitamins and minerals (68.2%) were used by the participants rather than other dietary supplements. The highest reported reasons to use dietary supplement were due to the doctor's advice (86%) and to improve the immunity functions (61%). Only 26.2% of the sample was considered about the manufacturing company of the dietary supplement. Only 37% of players were aware of the anti-doping practices and there was a significant difference (P value= 0.001) in the knowledge of Anti-Doping with respect to the level of participation of Karate players. Further, it was revealed that the sex of the sample was not affect the knowledge of anti-doping. Although the karate players in this study are using dietary supplements, their knowledge on anti-doping practices were not sufficient. Therefore, can suggest for responsible authorities to conduct awareness programs to the karate players in North Western province to improve their knowledge of anti-doping practices.

**Keywords:** *Anti-doping, dietary supplements, karate players, North Western province*

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## Comparative and Compliance Study on Sri Lankan Food Labelling and Advertising Regulation 2005

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The primary role of food labels is to inform consumers on ingredients, nutritional value, quality and safety parameters, health claims and cost of food products. Labelling is regulated as an effective tool to protect public health and safety and to prevent misleading or deceptive conduct of food manufacturers. Technological advances and developments in food trade over the time emphasize a greater need of continuous improvement of food labelling. In Sri Lanka, the last amendment of Food (Labelling and Advertising) Regulation (SLFLAR) was in the year 2005. In the comparative study, general and mandatory labelling provisions of CODEX STAN 1-1985, 2007 were taken into consideration and were compared against four other food labelling regulations and standards of international importance, namely FDA 21 CFR § 101, 2020, Regulation (EU) No 1169/2011, FSANZ ch.1, pt.1.2, FSSAI (Packaging and Labelling) 2011; ch.II, 2011 including SLFLAR 2005. Lack of nutritional labelling provisions is a major lapse of SLFLAR 2005. This scenario negatively affects Sri Lankan population who are vulnerable to nutritional transition due to increased consumption of packaged food. Traffic light colour coding for drinks and solid/ semisolid foods in Sri Lanka was identified as a positive trait under front of the pack. Compliance study conducted using market available food products revealed that compliance was satisfactory (> 95%) for provisions; net contents, list of ingredients, date mark, batch code, manufactures address and country of origin. Compliance to name of the food was not satisfactory (84%). Voluntary nutritional labelling was found in 63% of food items and it does not have one common format, due to inadequacies in the SLFLAR 2005. Considering both compliance and comparative studies, overall suggestions were proposed to upgrade the existing food labelling regulation especially emphasizing the need for a dedicated body to administer the requirements.

**Keywords:** *Food labelling regulation, mandatory requirements, nutritional labelling, nutritional claims*

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## **The Supplement Use among Gymnasium Instructors in Sri Lanka: A cross sectional study**

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Many attempt to improve their performances and maintain their fitness and performances in the current situation in the sports and exercise field. Individuals use dietary supplements to complete their objectives. Gymnasium instructors are the larger consumers of dietary supplements and they recommend dietary supplements for the gym users. Therefore, supplement use in the fitness industry has become very popular globally. The objective of this study was to assess the level of supplement used among gym instructors in Sri Lanka. A cross sectional online survey was carried out for the National Vocational Qualification Qualified male gym instructors who are listed in the Tertiary and Vocational Education Commission. One hundred and fifty NVQ qualified gym instructors aged between 18 to 48 in Sri Lanka participated in the survey. The participants reported that they are using at least one dietary supplement mentioned in the questionnaire. The frequencies of dietary supplement use reported from most consumed to least consumed were as follows; caffeinated drinks such as brewed coffee, cappuccino, frozen blended coffee drink, hot brewed tea and iced tea (90%), protein powder like whey, soy, hemp, rice (49%), plant extracts/herbal supplements (41%), individual vitamins such as Vitamin A, Vitamin C, Vitamin D, vitamin E, beta-carotene, B-complex and supplement. (35%), individual minerals such as calcium, chromium, folate (folic acid, folacin) Iron, magnesium(34%), vitamin and mineral supplements such as multiple vitamin/mineral supplement, mega/high potency vitamin, combination antioxidant supplements (31%), protein or sports bars and energy beverages (25%), branched-chain amino acids (22%), and caffeinated candy, gum, medications (15%). The sources of information most mentioned were internet (75%), friends (22%), papers (1%) and only 1% receive information from doctors. In a conclusion it is evident that all gyms instructors consume at least one dietary supplements and caffeinated drinks are the most consuming dietary supplement.

**Keywords:** *Caffeinated drinks, dietary supplements, gym instructors, NVQ qualified*

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## Improving Knowledge on Nutrition during Pregnancy among Couples from Rural Communities in Anuradhapura District: A Health Promotion Intervention

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Maternal nutritional status before and during pregnancy is a key factor that affects birth weight and childhood malnutrition. This study aimed to improve the knowledge of pregnant mothers and their spouses about maternal nutrition through a health promotion intervention. Four hundred and three (403) couples were recruited from antenatal clinics in Anuradhapura District. Focus group discussions on maintaining good maternal nutrition were conducted by health promotion facilitators; participants planned their meal according to model menus prepared from cheap, locally available food and maintained nutrition diaries/calendars throughout the pregnancy period. Knowledge was assessed using interviewer administered questionnaires at both before and after the intervention. The assessed indicators were: knew all the nutrient groups and knew two food items which contain carbohydrate, protein, iron, vitamin A and calcium. Paired t-test was used to compare pre and post intervention data. Approval from the ethics review committee of Faculty of Medicine, University of Colombo was obtained. Out of 403 mothers, only 347 (86.1%) and out of 403 partners, only 323 (80.1%) were included in the final analysis due to attrition. Mothers' level of knowledge improved significantly over time ( $P < 0.05$ ) in all indicators, except for naming food items rich of iron (43.2%) and vitamin A (28.8%). Proportions of correct responses by partners also improved significantly ( $P < 0.05$ ) in all indicators. Rice was the most commonly stated carbohydrate rich food by all couples. Fish was the commonest mentioned protein rich food by mothers, meat was by partners. Spinach and sprats were respectively the most mentioned iron and calcium rich food items by both spouses. The empowerment based health promotion model was effective in improving knowledge of pregnant mothers and their spouses about the maternal nutrition.

**Keywords:** Health promotion, Knowledge, Nutrition, Pregnancy, Rural communities

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## **A Health Promotion Intervention to improve Birth Weight of the Babies of Pregnant Mothers who are at Risk: A Quasi- Experimental Study**

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The indicators of child nutrition, including birth weight, have not improved recently in keeping with other health indicators in Sri Lanka. This was a quasi-experimental study. This study aimed to improve birth weight of babies of pregnant mothers who were at risk. Health promotion approach was used among 806 pregnant mothers recruited from antenatal services in Anuradhapura (IG; Intervention Group, n=403) and Polonnaruwa (CG; Control Group, n=403). Eighteen sub groups of risk were identified based on socio-demographic (eg: teenaged mothers), pregnancy related (eg: history of Low Birth Weight (LBW)), pregnancy outcome related (eg: pre-term deliveries) and intervention related (eg: low knowledge on nutrition) factors. Mothers in IG identified 09 determinants of LBW; maternal nutrition, rest, happiness, maternal infections, partner's support, care from others, indoor air pollution, exposure to tobacco smoke and poverty and implemented actions to address those. Mothers in CG did not implement these actions. Progress was monitored till the delivery of the child. The prevalence of LBW and mean birth weight in sub groups that resulted in singleton live births between the IG and CG were compared using descriptive and inferential statistics. When comparing with mothers in CG, prevalence of LBW was significantly less ( $P<0.05$ ) among the mothers in IG from the sub groups of nuclear families, partners living away from home, smoking partners, low maternal height, LBW history, unplanned pregnancies and Hb level less than 11g/dl. Mean birth weights of babies in IG were significantly higher: born to teenaged mothers ( $P=0.016$ ), nuclear families ( $P<0.001$ ), mothers with partners living away from home ( $P<0.001$ ), mothers with smoking partners ( $P=0.023$ ), primi mothers ( $P<0.001$ ), low pre-pregnancy BMI ( $P=0.005$ ), LBW history ( $p<0.001$ ) and unplanned pregnancies ( $P<0.001$ ). The community-based health promotion approach is significantly associated with the improved birth weight of the babies of pregnant mothers who are at risk.

**Keywords:** Birth weight, community based, health promotion, pregnant mothers

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## Basic Nutritional Knowledge and the Associated Factors of Newly Recruited School Sports Coaches in Eastern Province

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The school sports coaches were appointed to schools in each province according to the requirements. In the Eastern Province, 577 school sports coaches had been employed in 2019. Compared to other provinces based on the national level school sports meet points table, Eastern Province score was the lowest in the last 10 years. This study aimed to assess the basic nutritional knowledge among school sports coaches in Eastern Province. The population stratified as three districts and 35% of strata were selected as random sample. A standard questionnaire was used to collect data from school sports coaches. The Chi-Square test statistic with 0.05 significance was used to assess the association of awareness of nutrients, hydration, recovery, weight management, and supplements with the demographic factors such as age, duration of coaching experience, and education qualification. There was significant association of age hydration (0.48), recovery (0.007), weight management (0.045), and supplements (0.000); education qualification with hydration (0.007), nutrients (0.002), supplements (0.000); duration of coaching experience with hydration (0.001), nutrients (0.003), weight management (0.002) and supplements (0.002). Twenty percent of Eastern Province school sports coaches recorded a good level of basic nutrition knowledge.

**Keywords:** *Hydration, nutrients, recovery, supplements, weight management*

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## Macronutrient Adequacy and Body Composition of Sri Lankan National Sevens Rugby Players

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Dietary intake and body composition are among the key parameters determining the success of the sports career of a rugby player. The objectives of this study were to assess the macronutrient intake, body composition and daily energy requirement of Sri Lankan National Sevens rugby players to get a comprehensive knowledge of the adequacy of macronutrient intake. Fifteen athletes representing the National Sevens rugby team participated in the study. Approval from the team officials was obtained before recruiting participants. The participants were briefed about the study procedure and explained that their subsequent agreement to participate in the study was on a completely voluntary basis. Informed written consent was obtained from all participants before data collection. The macronutrient intake of the participants was assessed using a 24-hr dietary recall throughout 3 days. Body composition of participants was assessed using bioelectrical impedance. The physical activity levels of the subjects were assessed using a validated questionnaire and the estimated energy requirement (EER) was calculated using a standard equation. The mean daily calorie intake of the participants was 3525.7 kcal against the mean EER of 3519.4 kcal. All the players (n=15) achieved Accepted Macronutrient Distribution Ratio (AMDR) and the Recommended Dietary Allowance (RDA) for carbohydrates and proteins. The mean whole-body skeletal muscle mass and whole-body fat percentages of the participants were 33.84% and 21.8%, respectively, which were within the normal ranges for a healthy individual. In conclusion, the energy and macronutrient requirements of the participants are fulfilled through their diet. All the participants achieved RDA and AMDR recommendations for macronutrients through their diet, which is indicated by their body composition.

**Keywords:** *Body composition, energy requirement, macronutrient adequacy, rugby players.*

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## **Use of Health Promotion Approach to Minimize Social Influences Affecting Community Nutrition.**

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Community nutrition is under social influences. All members of the human community are Consumers or customers at some point. Community members choose food items for themselves or for someone else. Those foods can be whole or partially prepared or raw. The place where those choices are made can be the dining table, the kitchen, the general market, the supermarket, the restaurant, the workplace, the office, or the farm. So there are a number of factors that influence these choices. We know that there are social influences between those things. As social stimulants, the influence of loved ones, place of study, workplace, media advertising, social media advertising, cinema, television, best friends, supermarket food display art, taste, social level, social values, current social feedback, community value, beliefs, social values, health status and amount of money in the wallet. They identified themselves (health setting) as the underlying factors influencing their nutrition. Community nutrition is strengthened when they are empowered to determine the underlying factors that affect them and to take full control of those underlying factors. Using the health promotion approach, the social stimuli that affect community nutrition, the power and ability to behave, and the methodology they use to strengthen community nutrition can be described as follows. A group of ten non-working mothers living in my village selected and built a small health setting. The ten housewives discussed and recorded in a book all the ingredients and additives and quantities of food brought in and out next month. Then, they analysed them by classifying them as artificial/natural, nutritional value, likes / dislikes, colour, properties / negatives, needs and tastes. They listed the underlying factors that influenced their choices. Then, they were prioritized by themselves. From those underline factors; they were not taken to address uncontrollable and difficult social influences. The activities were organized at the family level after discussing the impact of these social influences on the health and economy of their families by their husbands, children, and parents. Activities designed for each of these family units were shared among the ten mothers. Instead of artificial flavours, local spices are used to prepare flavours, share cooking secrets, minimize artificial and fast food, gardening, adding natural vegetables and fruits, using local household utensils such as grinders, mortar and pestle. Activities such as doing, family gatherings and working at home increased their happiness day by day. A happy calendar marking the happiness of family members was maintained. Monthly body mass index and its difference were monitored. The amount of money left over in each month was assessed. Blood glucose levels were estimated. They shared the knowledge and experiences. The happiness of families was greater than the beginning of the health promotion process. Their self-esteem has grown. . Appropriate management of household nutritional needs protected the economy and health. The ten mothers were determined to share their health promotion experiences with others in the village. The community has the power to develop positive social influences that affect community nutrition and to maintain its nutritional quality by eliminating negative influences.

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**Keywords:** *Health promotion approach, health setting, household nutritional needs, underline Factors,*

## **Empowering Caregivers to Provide Proper Nutrition for Children During Early Childhood: A Health Promotion Intervention**

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Nutrition during the early childhood period can seriously interfere with morbidity, brain development and later impact on the health and wellbeing of a child. Therefore, it is important in empowering caregivers to provide proper nutrition. This health promotion intervention aimed to empower the mothers to provide proper nutrition for children during the early childhood period. This intervention was carried out for 6 months with 35 mothers having children under 5 years in a rural village. Group discussions were conducted on the importance of proper nutrition during early childhood and identified insufficient food intake of children and low willingness of children to take nutritious food as the main underlying factors for poor nutrition. Then, improved the enthusiasm of mothers using success stories of health promotion interventions and facilitated to design and implementation of activities to address those factors. At the end of the process, changes were assessed qualitatively through focus group discussions and data was analyzed using thematic analysis. A common place in the village was selected and twice a month, collective feeding was conducted by mothers having under 5 children. Elders and adolescents also engaged with five senses stimulations through their participation in collective feedings. Children were not given junk foods and drinks. Mothers followed simple strategies like preparing vegetables with different colors, and different shapes to increase the interest of children in homemade foods. Mothers added a powder called “*Vibhaga Pohora*” which was made by drying drumstick leaves and sprat heads to increase the tasty and iron content in foods. According to mothers’ tells, children eat well than before and 83.9% of mothers (n=29) said, their children have increased weight gain compared to the period before the intervention. Based on the results, it can be concluded that the health promotion intervention was effective in empowering caregivers to provide proper nutrition for children during the early childhood period.

**Keywords:** *Early childhood, empowering caregivers, health promotion intervention, nutrition*

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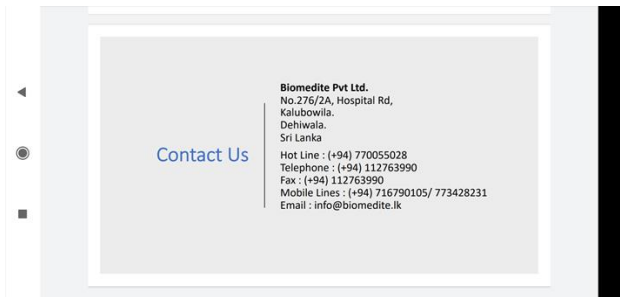
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