THE NUTRITION SOCIETY OF SRI LANKA

"Exploring New Horizons and Strengthening the Food Systems for Health and Nutritional Well-being"

PROCEEDINGS

ANNUAL SCIENTIFIC SESSIONS
OF THE NUTRITION SOCIETY OF SRI LANKA
2023

Proceedings of the Annual Scientific Sessions

of

The Nutrition Society of Sri Lanka

'Exploring New Horizons and Strengthening the Food Systems for Health and Nutritional Well-being'

21st – 22nd January 2023
at Hotel Mandarina, Colombo 3

Editor: Prof. Ananda Chandrasekara

Editorial Assistance: Ms. Sinali Weerasekara

Cover Design: Mr Sampath Kumara Herath

Proceedings of the Annual Scientific Sessions of the Nutrition Society of Sri Lanka
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"Exploring New Horizons and Strengthening the Food Systems for Health and Nutritional Well-being"	
DAY 1 Programme: Saturday 21st January 2023	
Time	**Event**
8.00 am	**Registration**
8.10 a.m.	**Lighting of oil lamp & National Anthem**
8.15 a.m.	**Welcome Speech** Dr. Dhammika Senanayake, President, NSSL
8.20 a.m.	**Address by the Chief Guest** Senior Professor (Chair) H.D. Karunaratne - Vice Chancellor, University of Colombo
8.30 a.m.	**Keynote Address** **Causality and Measurement of Nutrition Status of Children Under Five Years** Dr. Soma De Silva, Former Regional Adviser, UNICEF South Asia
9.00 a.m.	**Presidential Address** **High Performance Sports and Dietary Supplements: Sri Lanka Context** Dr. Dhammika Senanayake, President, NSSL
9.15 a.m.	**Vote of Thanks** Ms. Thamilini Joshepkumar, Joint Secretary, NSSL
9.20 a.m.	**TEA BREAK**
9.45 a.m.	**Symposium 1** **Healthy Food Innovations and Future of Food** **Symposium Chair: *Prof. Renuka Silva (Past President, NSSL)*** *Chair Professor, Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka* Plenary Lecture **Sri Lankan Traditional Rice: Nutritional Consequences of Processing** Snr. Prof. Sagarika Ekanayake, Senior Professor in Biochemistry, University of Sri Jayewardenepura
10.15 a.m.	Symposium Lecture **How Innovation Will Shape the Future of Food** Prof. Niranjalie Perera, Department of Food Science and Technology, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka
10.35 a.m.	Symposium Lecture **Role of Biotechnology in Global Food Security and Nutrition** Prof. Nilantha Liyanage, Department of Food Science and Technology, Faculty of Agriculture, University of Ruhuna
10.55 a.m.	**Q & A session**
11.10 a.m.	**Appreciations**
11.15 a.m.	**Symposium 2** **Re-imagining the Future of Child Nutrition** **Symposium Chair: *Snr. Prof. Narada Warnasuriya (Past President, NSSL)*** *Emeritus Professor, University of Sri Jayewardenepura* *Senior Professor of Pediatrics, Faculty of Medicine, General Sir John Kotelawala Defence University*
11.45 p.m.	Plenary Lecture **Current Status and Way Forward in Child Nutrition** Snr. Prof. Pujitha Wickramasinghe, Senior Professor of Pediatrics, Faculty of Medicine, University of Colombo

12.05 p.m.	Symposium Lecture **Hidden Hunger in Children** Prof. T. Kudagammana, Professor of Pediatrics, Faculty of Medicine, University of Peradeniya
12.20 p.m.	Symposium Lecture **Healthy Eating Interventions to Promote Dietary Behaviors of Young Population** Dr. Fathima Sirasa, Senior Lecturer, Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka **Q & A session**
12.30 p.m.	**Appreciations**
12.35 p.m.	**LUNCH BREAK & POSTER COMMUNICATIONS**
	Poster Evaluation Judges: Mr. Wilfred Narammala, Former Deputy Director (SLPS) Dr. G.R. Nipuni Nayanathara Waidyarathna, Senior Lecturer in Biochemistry, Department of Pre-Clinical Sciences, Faculty of Medicine, General Sir John Kotelawala Defence University
1.30 p.m.	**Symposium 3** **Healthy Lifestyle and Non- Communicable Diseases** **Symposium Chair:** ***Vidyajyothi Prof. Arjuna. P. de Silva*** *Senior Professor, Faculty of Medicine, University of Kelaniya* Plenary Lecture I **Dietary and Behavioural Modifications to Combat Cardiovascular Diseases** Air Cdre (Prof.) RANK Wijesinghe, Professor of Medicine, Dean, Faculty of Medicine, General Sir John Kotelawala Defence University
2.00 p.m.	Plenary Lecture II **NCD burden in 21st Century: Evidence based management.** Dr (Ms.) Daminda Attanayake, Sports and Exercise Physician, Head of the Rehabilitation Unit at Institute of Sports Medicine
2.20 p.m.	Symposium Lecture **Physical Activity is a Medicine for Non-Communicable Diseases** Dr. H.R.L.K. Hettige, Acting Consultant in Sport and Exercise Medicine, Lady Ridgeway Hospital
2.40 p.m.	Symposium Lecture **Healthy Lifestyle Choices Can Overcome the Genetic Risk of Obesity** Prof. Vimal Karani S, Professor in Nutrigenetics & Nutrigenomics, Dept. of Food and Nutritional Sciences, University of Reading, UK **Q & A session**
3.10 p.m.	**Appreciations**
3.15 p.m.	**TEA BREAK**
3.30 p.m.	**Prof. C.C De Silva Memorial Oration - Can Diet Replace Medicine?** **Prof. Ananda Chandrasekara**, Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka
4.30 p.m.	**Awards & Appreciations**
4.35 p.m.	**NSSL Annual General Meeting**
7.00 p.m.	**The Nutrition Society of Sri Lanka Annual Celebration Dinner** **"Pearl Grand By Rathna"** 09, Edward Ln, Colombo 3

DAY 2 VIRTUAL PROGRAMME: Sunday 22nd January 2023	
8.30 a.m.	**Symposium 4** ***Food Security & Nutritional Wellbeing in the Time of Crisis*** **Symposium Chair:** ***Prof. Renuka Silva (Past-President, NSSL)*** *Chair Professor, Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka* Plenary Lecture **Navigating the Nutrition and Food Insecurity in Sri Lanka: Solutions to a Better Tomorrow** Snr. Prof. D.K.N.G Pushpakumara, Department of Crop Science, Faculty of Agriculture, University of Peradeniya
9.00 a.m.	Symposium Lecture **Fruit and Vegetables for Sustainable Healthy Diets (FRESH)** Dr. Deanna Olney, Senior Research Fellow, International Food Policy Research Institute, USA
9.20 a.m.	Symposium Lecture **Nudging for Good: Real-time AI-driven Diagnostics and Behavior Change to Improve Adolescents' Diets and Nutrition** Dr. Aulo Gelli, Research Fellow, International Food Policy Research Institute, USA
9.40 a.m.	**Q & A session**
10.00 a.m.	**Appreciations**
10.15 a.m.	**TEA BREAK**
10.30 a.m.	**Oral Presentations on Free Communications** **Applied Nutrition in Clinical Practice** **Session Chair:** *Dr. Kanchana Abeysekara, Senior Lecturer, Department of Agricultural Technology, Faculty of Technology* **Session Judges:** ● Prof. Usha Hettiaratchi, Professor in Biochemistry, Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura ● Dr. Maduka de Lanerolle-Dias, Senior Lecturer, Department of Biochemistry & Molecular Biology, Faculty of Medicine, University of Colombo
1.00 p.m.	**LUNCH BREAK**
1.30 p.m.	**Oral Presentations on Free Communications** **Community Nutrition and Food Security** **Session Chair:** *Dr. Sanath Mahawithanage. Senior Lecturer, Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura* **Session Judges:** ● Prof. Niranjalie Perera, Department of Food Science and Technology, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka ● Dr. Geeshani Somaratne, Lecturer, Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya
4.00 p.m.	**Awards & Appreciations**
4.10 p.m.	**Closing Remarks** Prof. Ananda Chandrasekara, Conference Editor, NSSL Annual Sessions 2023
4.15 p.m.	**End of the Day**

Message from the President, NSSL

It gives me great honor and privilege to inform you that the council of The Nutrition Society of Sri Lanka (NSSL) 2022-2023 has been able to arrange the Annual Scientific Sessions- 2023 as a Hybrid event among the uncertainties after the global pandemic and with the local financial crisis.
The NSSL is the oldest professional body in the field of nutrition operating in the country. Being initiated in 1971 and being established as a formal society in 1972, the NSSL marked its golden jubilee in 2022. It is a recognized society that had been incorporated by the Parliamentary Act No 5 of the Democratic Socialist Republic of Sri Lanka in January 1985. Even though the society had been initiated by a group of medical professionals who were interested in nutrition, the membership was opened even to the other professionals in the allied fields, allowing a broad-based membership of NSSL to work collaboratively and fruitfully towards the multi-sectoral approach in nutrition. The diversity together is our strength. It is my wish that NSSL members of all entities would work together in unity for the betterment of the general public in the country.

It's my pleasure to document that we as the council continuously organizing events which were started to celebrate the 50th anniversary of the NSSL last year. Organizing Mobile Photography Challenge for Youth, the NutriEssay competition, and NutriCa Arts competition for school children are among the activities already completed in 2023. Along with the golden jubilee, the council organized the launching of an official journal for the NSSL- The Journal of Nutrition and Food Sciences and a webpage for the digital repository of nutrition-related local research publications and a fundraising program to establish a permanent office premise for the NSSL.

I have great pleasure in welcoming all of you to the inauguration ceremony and the technical sessions of the Annual Scientific Sessions under the theme of "Exploring New Horizons and Strengthening the Food System for Health and Nutritional Well-being". We have many dignitaries with us joining online and in person. I am deeply honored to welcome our chief guest, Senior Professor H D Karunaratne, Vice-Chancellor, University of Colombo, and the Guest of Honor Mr. Amal Edirisooriya, Director General, Sports Development Department.
We, as the council has decided to invite the past presidents of the NSSL to most of the items in the Annual Scientific sessions which will help to bring back the memories of the past. I would like to extend my warm welcome to all the symposium chairpersons as well. I warmly welcome all the distinguished guests, invitees, speakers, judges, presenters and life members. Organizing an activity of this nature does not happen overnight. It is indeed a tireless task that was only possible through the persistent efforts and dedication of the members of the NSSL Council, my energetic family. Council was the strength behind me and my gratitude to them sees no bounds.
I convey my special acknowledgment to all the funding agents who funded NSSL activities during 2022 amidst financial constraints.
The NSSL Annual Scientific Sessions is one of the most enriched forums for sharing knowledge, reviewing, and showcasing scientific output in the field of nutrition. I convey my best wishes towards the success of the Annual Scientific Sessions 2023 of the NSSL.

Dr Dhammika Senanayake
President, NSSL

Message from the Secretary, NSSL

It is my great pleasure to write this message on behalf of the Nutrition Society of Sri Lanka. First of all, let me welcome you all to this leading annual session that has been providing platform for young scientists to present, discuss, debate and validate their research findings at a distinguished forum.

Let me start off by extending our heartfelt gratitude to our Chief Guest, Senior Professor H D Karunarathna, Vice Chancellor, University of Colombo, who honored this function with his inspirational thoughts. I would also like to thank the keynote speaker, Dr. Soma De Silva, Former Regional Advisor, UNICEF. Dear Madam, your valuable insights helped us ignite the momentum and highlighted our role during this unprecedented time as a professional network.

We have outstanding events in line for you for two days, and the event is enriched by invited presentations of the eminent Scientists from different institutions from different parts of the country. My sincere appreciation and gratitude go to all Symposium speakers, Judges, Abstract reviewers, Award application evaluators, awardees, all presenters and all who contributed in numerous ways to make this scientific session a monumental success.

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. Thank you so much for your collaboration in identifying your social responsibility and partnering with us in this important endeavor.

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 this very fine and capable group of people. My sincere thanks to all the delegates, including other distinguished guests and the participants, members of the NSSL. This event would not be a success if it weren't for your involvement.

Last but not least, I must mention the support provided by the council members of the NSSL. Thank you, team! without our collective effort, this achievement would be a nightmare.

While begging your pardon for any omission or any inconvenience, I wish you all a Happy, healthy, and prosperous new year in which we will be able to better march towards our mission!

Ms. Thamilini Joshepkumar
Joint Secretary, NSSL

Message from the Conference Chair, Annual Scientific Sessions of NNSL – 2023

The Nutrition Society of Sri Lanka (NSSL) links nutritionists, other healthcare professionals, scientists and all interested parties of the field of Nutrition together with the aim of promoting nutritional status of the country. The Annual scientific sessions of the Nutrition Society of Sri Lanka is the key scientific forum that provides the ideal platform for the Sri Lankan professionals in the field of Food and Nutrition and the researchers to discuss and debate on nutrition-related research findings and the latest advancement of nutrition science. This year has been a significant year for the nutrition society as the council of the NSSL has decided to hold this annual prestigious conference physically after the pandemic.

In two days programme under the theme of "Exploring New Horizons and Strengthening the Food Systems for Health and Nutritional Well-being" we hope to conduct four symposiums namely Healthy food innovations and future of food, Re-imagining the future of child nutrition, Healthy lifestyle and non- communicable diseases and food security & nutritional wellbeing in the time of crisis. This year, in response to the call for abstracts, of which the best was selected for the sessions following a rigorous review process. Given the limited time in the two-day programme, the number of oral presentations were restricted to 28 while the rest (22) was accommodated as poster presentations. The free communications span over a wide array of areas relating to food, nutrition and health. In addition, free papers presented by the researchers will add much enthusiastic thoughts on current nutrition issues and opportunities to combat them.

I strongly believe that these sessions will allow the participants a productive discourse not only in aspiring excellence in nutrition science, but also about how it relates to nutritional wellbeing of the Sri Lankans. Some of the underlying nutrition problems in vulnerable groups in the time of crisis and way forward in re-imagining the future of child nutrition will be discussed in depth during the Annual Scientific Sessions 2023, by our keynote and guest speakers.

As a conference chair, I know that the success of the conference depends ultimately on the many people who have worked with us, in planning and organizing the conference. I'm constantly amazed by the dedication and enthusiasm of the President of the society Dr. Dhammika Senanayake and all the council members. I wish to express my sincere gratitude to the chief guest Senior Professor (Chair) H.D. Karunaratne, Vice Chancellor, University of Colombo and the guest of honor Mr Amal Edirisooriya, Director General in sports. Further, I extend my heartfelt appreciation to Dr Soma De Silva, Former Regional Adviser, UNICEF South Asia, the keynote speaker, symposium chairs, guest speakers, judges, abstract reviewers, award application evaluators, and budding researchers who share their exciting research findings. My special thanks go to Prof Ananda Chandrasekara, the orator of the Prof C.C De Silva memorial oration.

In particular, I thank the conference organizing committee for their wise advice and brilliant suggestions on organizing the conference. All recognition should go to the committee members who have all worked extremely hard on the details of important aspects of the conference programme.

Finally, I would like to thank our sponsors for their generous financial assistance as this event would not have been possible without their support.

On behalf of the Conference Committee, we're looking forward to seeing you at Colombo.

Dr Kumari M Rathnayake

Conference Chair - Annual Scientific Sessions of the NSSL- 2023

Keynote Address
Making Nutrition Interventions Successful

***Dr (Mrs) Soma De* Silva**
Former Regional Adviser, UNICEF South Asia

Child nutrition is essential to reduce mortality and prevent cognitive function impairment. However, malnutrition has prevailed, resisting numerous interventions. This keynote speech proposes examining reasons for the lack of success of nutrition interventions from the perspectives of planning, monitoring, and evaluating such interventions. Interventions for reducing malnutrition, like other development interventions, need proper planning. Such plans need to be results-focused, theoretically grounded, and evidence-informed. They must meet the criteria for successful development interventions: relevance, effectiveness, efficiency, effectiveness, impact, sustainability, and coherence. Implementing these plans requires monitoring with a results focus, and results should be used for corrective actions. Further, nutrition interventions need to be selectively evaluated to generate knowledge and evidence on whether the right actions are done and whether they are done right. Evaluative knowledge thus gained should be used to continually improve nutrition intervention planning and implementation to reduce malnutrition and reach targets.

Prof. C.C De Silva Memorial Oration
Can diet replace medicine?

Prof. Ananda Chandrasekara
Department of Applied Nutrition, Wayamba University of Sri Lanka

World Health Organization estimates 74% of total global deaths, equivalents to 41 million people, each year occurred due to Noncommunicable diseases (NCDs). 77% these NCDs deaths are occurred in low- and middle-income countries. These include 17.9 million deaths due to cardiovascular disease and 2 million due to diabetes. Non-communicable diseases, account for nearly 90 percent of the disease burden in Sri Lanka. There has been a rapid increase in the overnutrition and its co-morbidities during the last several decades reflecting epidemiological transition in parallel to the rapid urbanization, change in lifestyle and dietary practices. Increasing rates of obesity are associated with the NCDs, subsequently increasing burden to the health infrastructure and to the shrinking health budget, causing a serious challenge to Sri Lanka's healthcare system. The increased prevalence of chronic NCDs between 1990 and 2017 reflecting change in lifestyle and dietary behavior. Therefore, efforts to prevent and reverse the effects of burden malnutrition in the country should be addressed.

Due to the current changes and trends in Sri Lanka's diet and behavior, distinct forms of malnutrition as well as related non-communicable diseases have become more prevalent. High calorie diets and sedentary lifestyles are majorly responsible for the burden. Nutrition offers effective and economical ways to reduce the burden of these diseases and their associated risk factors. As obesity, a well recognize NCD risk factor, heart disease, diabetes, and other life-threatening conditions rapidly increase, the public is gradually realizing that scientific awareness is essential to maintain health and well-being. People need skills to change nutrition and health behaviours. Because low-income status has been shown to correlate with reduced access to educational resources, learning how to incorporate nutritious foods into household budget may be challenging. There were knowledge gaps on prevailing nutrition issues in the community. However, applying knowledge into practice has several barriers including poverty, ignorance or lack of motivation, high cost of heathy foods, lack of time, lack of support and unavailability of nutritious foods. Due to increased media awareness, there has been a considerable concern among public on the safety of the food available for consumption. In between, various misconceptions about nutrition are constantly being circulated through print and electronic media, and through social networks. There is a widespread belief that the higher incidents of NCDs such as cancer, diabetes, kidney disease are mainly caused by the consumption of chemical contaminated food. This speculation is predominantly shared by a section of professionals who categorically relate and describe "foods including fruits and vegetable are full of poisons". A larger section of Sri Lankans in public has a belief that excessive amounts of chemicals are added in the process of during the operations of food production and processing. This further misleads the consumers at large and it is often seen these

unscientific ideologies are promoted throughout the media. With the range of information and opinions and so many choices and decisions, it can be hard to know what to do and which information you can trust. Scientific information backed by nutrition research data holds the key to increasing understanding of the scenario. Therefore, it is vital to look for the scientific facts backed findings from the research that stimulate the adoption of innovative strategies that can be applied to maintain health and well-being.

The management and control of NCDs requires a lifecycle approach with a strong focus on preventive care, and this has warranted a reorganization of the country's primary healthcare system. Poor quality of diets is among the leading causative factor contributing to the global burden of disease. Good nutrition is vital in ensuring health and well-being. However, there is often a significant disconnect between health and agriculture and administrative bureaucracy does not recognise sufficiently the requirement of intersectoral coordination that would facilitate relationship between the two fields of agriculture and health. Agricultural sector development is meant to provide food sufficiently to ensure food security as well as nutritional security," the agriculture sector should focus beyond just calories but also to provide healthy and nutritious foods. Health sector should focus on lifestyle management of the consumers by administering and evaluating actions and outcomes. An important way to control NCDs is to focus on reducing the risk factors associated with these diseases. According to WHO Low-cost solutions exist to reduce the burden of NCDs. "To lessen the impact of NCDs on individuals and society, a comprehensive approach is needed requiring all sectors, including health, finance, transport, education, agriculture, planning and others, to collaborate to reduce the risks associated with NCDs, and to promote interventions to prevent and control them". Transformation of dietary behavior is imperative influenced by multiple sectors involvement including policy changes.

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Symposium 1: Healthy Food Innovations and Future of Food

Plenary Lecture

Sri Lankan Traditional Rice: Nutritional Consequences of Processing

Snr. Prof. Sagarika Ekanayake
Senior Professor in Biochemistry, University of Sri Jayawardenepura

As elsewhere in Asia rice is the staple food among Sri Lankans and is the meal consumed twice a day by majority. Per capita consumption of rice amounts to 315g /day with 114 kg /year of rice and rice-based products. Rice provides 40% total calorie and 31% protein requirement of an average Sri Lankan. In addition, rice is a source of minerals, vitamins, dietary fiber and other substances needed for good health. However, these vary in content depending on the variety and processing of rice. Rice is available as raw whole grains, raw polished or parboiled rice which are not very popular. Rice varieties which are mostly consumed at present were introduced in Sri Lanka in 1960 with the Green revolution and technology developments leading to replacement of cultivation and consumption of traditional varieties with more refined and improved rice.

The current high prevalence of nutrition-related NCDs among Sri Lankans is partly attributed to consumption of highly milled, refined rice in addition to sedentary life, lack of adequate vegetables fruits, physical activity etc. In this context Sri Lankan traditional rice varieties have become more popular as they possess many nutritional and medicinal properties as evidenced by our indigenous medicine practices. More importantly, traditional rice farming is considered to be environmentally friendly, economically viable, and sustainable as they can tolerate biotic stresses, pests and diseases. Thus, in an era where sustainability is being addressed globally, traditional rice cultivation may have high significance.

The contents of macronutrients, dietary fiber, micronutrients and other bioactive compounds of many traditional rice are available but mainly of uncooked whole grain rice. In order to scientifically validate the popularity of traditional rice in the current context of high prevalence of NCDs and their popularity it is of value to study how different processing and more appreciably, cooking affect the nutrients in rice to uphold traditional rice varieties as a healthy staple.

In an attempt to address the above traditional rice varieties (06) which were differently processed, and cooked were studied comparatively to assess the nutrient contents and glycaemic responses. The digestible carbohydrate (DC) content in rice flour varied with processing rice is subjected to with raw rice containing the least, demonstrating suitability in food production or consumption than raw polished which contained the highest amount. Parboiled traditional rice had lower DC than raw polished which decreased when cooked, proving their suitability for consumption if the intention is to reduce the caloric intake and control blood sugar. In addition, when considering cooked rice (100g) parboiled rice contained significantly lower content (< 16%) of DC compared to raw (24-26%) and raw polished (>26%). The reduction in DC in parboiled rice when cooked was due to higher water content retained (78-85% moisture).

Consequently, consumption of traditional parboiled rice will significantly lower the carbohydrate intake irrespective of variety and are much suited for "Low carb" / "low energy" diets.

The protein content was less than 4% in differently processed cooked rice with highest protein in raw unpolished rice (2.7-3.7%). Protein was about 40% less in parboiled rice due to high moisture, but the decrease is not as significant as carbohydrate due to lower protein content in cooked rice. In contrast, flour of uncooked unpolished and parboiled rice had higher protein compared to raw polished rice. Thus raw unpolished traditional rice flour with about 10% protein are immensely suitable for industrial use for food development as an alternative flour partly to substitute wheat. Fat content (<2%) was found to be higher in raw unpolished and parboiled rice flour due to the presence of bran layer and the germ. Cooked raw polished rice varieties had the highest crude fat content with parboiled and polished rice having similar amounts. Parboiled and raw unpolished rice contained the highest total dietary fibre (TDF) with least found in raw polished rice flour. A significant observation was following cooking the TDF content increased in all differently processed varieties with the highest increase in raw unpolished and parboiled rice. This is an observation not reported so far.

Starchy foods when subjected to heat, a fraction of digestible carbohydrate is converted to resistant starch due to retrogradation which is considered as dietary fibre. Foods high in resistant starch lower the glycemic and insulin responses and reduce the disease risk such as obesity, type 2 diabetes and cardiovascular diseases. The effect of cooking on RS content has not been reported before and it was found that a significant increase occurred following cooking all differently processed rice varieties. Following cooking parboiled rice flour had the highest RS (6-7 fold increase) with least in raw polished rice flour (2-3 fold). This also correlated with the increase in DF following cooking traditional rice varieties.

When the glycaemic indices of these varieties were studied parboiled rice elicited the lowest peaking and glycaemic curves whereas raw polished rice elicited highest peak and curve. The GIs of raw unpolished red rice varieties were (54-69) either low or medium and when subjected to polishing (4%) an increase in GI was observed for all varieties (69-74). However, parboiling the same varieties decreased the GI to low GI range (44-48). Similarly in white rice varieties, parboiled rice elicited low GI (43-44) and polished rice elicited high GI (73-74). Low GI food consumption is related with many health benefits and based on scientific evidence many organizations directly recommended or suggested the use of low GI foods in managing/controlling the glycaemic and lipidemic responses and hence the development of NCDs.

Glycaemic load (GL) expresses the glycaemic carbohydrates in an edible portion of rice and is calculated using GI and carbohydrate in an edible portion. When considering portion sizes, the volume of cooked parboiled rice was highest (282-412g) due mainly to the high water content imbibed followed by raw unpolished (185-224g) and raw polished (140-164g). Thus the amount of parboiled rice a person could consume is less when compared to raw and raw polished rice containing the same amount of digestible carbohydrate. Hence for an edible portion, the GL is least in parboiled rice.

Thus consumption of these parboiled traditional rice varieties which contain high resistant starch, fibre, high amylose leading to low glycaemic index and high moisture/low DC decreasing the glycaemic load compared to raw unpolished or raw polished are immensely suitable in reducing complications due to NCDs and for leading a healthier life. Raw unpolished rice flour also has a high potential to be used in food industry as a healthy alternative. Thus, fighting the high provenance of NCDs and improving the health of people while contributing to sustainability, Sri Lankan traditional rice especially parboiled rice could play a significant role.

Symposium Lecture

How Innovation will Shape the Future of Food

Prof. Niranjalie Perera
Department of Food Science and Technology, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka

The future of the world's food supply may well originate in the turbulent. The future of food production, innovation and engineering could look very different from what we have taken for granted in the present day. The incorporation of several disciplines into the singular process of producing food could see the advent of a so-called post-animal bioeconomy.

So, what will be on our plates in the next few decades? Experts have some pretty good ideas of what to expect. Still, with a shift to more sustainable farming and resource conservation, as well as a focus on eating locally, seasonally and plant based as much as possible, we can ensure there is enough food, particularly fruits and vegetables, for the growing population. Here are some innovations to expect to see more of in the coming years.

3D Food Printing Could Change Food Forever

With the widespread adoption of 3D printing in recent years, this development was almost certainly unavoidable. The technology will function as expected, with the end product being built layer by layer. In the future, this solution will provide limitless possibilities for the shape, texture, composition, and, ultimately, taste of food products. 3D printing will greatly reduce the waste produced by 'conventional' cooking and could be used to promote healthy high-tech food and completely redefine how we produce 'recipes'. Hopefully, the technology will allow for an infinite number of novel food designs by manipulating the ratio of ingredients to their final physical form on the plate. We are beginning to see future 'chefs' combining their culinary talents to push the boundaries of the artistic form of the food sculptor.

High-Pressure Processing Could Extend the Shelf Life of Food

One of the primary concerns for food producers is how to increase shelf life without sacrificing colour, taste or quality. This has been a problem since time immemorial, with early solutions such as smoke or salt curing, fermentation, and other thermal processing methods in widespread use since antiquity. High-Pressure Processing (HPP) is a non-thermal food processing technology which is currently being developed. This is a conservation technique that, could extend the shelf life of many food products.

Insect /animal derived protein Could Replace Beef, Chicken, Pork, and Lamb

Although eating arthropods, such as insects, is common in many countries around the world, it is less common in the 'West' - unless we exclude things like lobsters and crabs. This is about to change, as Kickstarter projects which hope to make insect protein bars and other foods more common in our diets.

If its popularity grows, it has the potential to create an entirely new industry and many jobs. Insect protein contains approximately 60% protein, is high in vitamin B12, and contains more calcium than milk. It also contains more iron than spinach and can provide the body with all of the essential amino

acids it requires. Insect meat is also better for the environment than its four-legged counterparts. Meal worms powder is also an alternative protein source.

Lab-Grown Meat Could Make Animal Farms and Abattoirs Obsolete

Lab-grown meat, also known as *in vitro* animals or "clean meat," may also pave the way for a new type of sustainable engineering in meat production. This 'meat' is made from stem cells harvested via biopsy from donor livestock and cultured in a lab for a few weeks. Environmentalists believe that *in vitro* meat could significantly reduce the environmental impact of large-scale animal husbandry. According to some estimates, if implemented on a large scale, 'greenhouse gas' emissions, particularly methane, could be reduced by 96%. Products like chicken nuggets, sausage, and even foie gras could be created by this technique. Of course, public sentiment and the market's "invisible hand" will ultimately decide this new industry's mainstream success.

Wild Grains and Cereals

The wheat you've grown to know and love (who can resist a slice of cake, freshly baked cookies, or homemade breads made with wheat flour?) is likely to be swapped for more abundant grains, cereals and pseudocereals in the coming decades. The wheat we use regularly has undergone selective breeding for years, leaving little genetic variation and creating a vulnerable crop that struggles to adapt, a major issue amid climate change. Instead, many people will learn to cook and bake with different grains or pseudocereals, which can be eaten like grains but are technically neither grains nor grasses. Plan to increase the quantities of quinoa, amaranth, buckwheat and fonio in the diet. The other benefit to these foods is that they are suitable for people with gluten intolerance.

Nutraceuticals

There is growing concern about the impact of food habits on health, as well as an increased demand for essential nutrients for a healthy lifestyle. Consumers are focusing more on eating healthy as a result of the COVID-19 pandemic, making nutraceuticals a top trend in the food industry. This is an important factor in driving the demand for nutraceuticals. These include nutritional supplements, functional foods, medicinal foods, and foods that improve the gut microbiome, such as prebiotics, probiotics, and synbiotics. Various nutraceuticals provide health benefits against oxidative stress-related disorders such as allergy, Alzheimer's, diabetes, and immune diseases.

Nano encapsulation

Nano-scale control over food molecules may lead to the modification of many macro-scale characteristics, such as texture, taste, other sensory attributes, processability and stability during shelf life. Encapsulation is a technique by which the sensitive ingredients are packed within a coating or wall material. The wall material protects the sensitive ingredients against adverse reaction and controls release of the ingredients. In addition, encapsulation process can convert liquids into powders, which are easy to handle.

Algae/seaweed

Algae and other marine sources of food will become more abundant, especially with the depletion of nutrients in soil from conventional agricultural practices. Algae can be farmed and grown quickly and in abundance, while also providing essential nutrients including protein, iron and antioxidants. Those who enjoy adding some spirulina to their smoothies are already keen on the benefits algae can offer. It will become important, as algae may provide a more efficient protein to land use ratio compared to current popular crops, like soybeans. You may already eat seaweed from time to time, and it has been enjoyed as a food source for centuries. But we'll be eating it in more ways in the future, from savory to sweet applications. In fact, production of beans, lentils and nuts is expected to increase nearly 100% to 200% by 2050, while red meat protein sources are expected to decrease in production by about 75%.

False Bananas

Globally, humans consume an estimated 100 billion bananas per year, in part due to increasing yields because of climate change. That's right — bananas have historically thrived in a warming world, but studies show that the crop will soon hit a peak and begin to see a drop in yields, making this popular fruit less available and more expensive. A related crop, the false banana, is already a staple in Ethiopia and is expected to become highly sought after globally. Just 15 false banana plants could feed one person for a year and are calorie-dense, earning the plant the nickname the "tree against hunger." This plant can also be harvested year-round.

Heat-Resistant Coffee

Your favorite morning beverage is at risk, but a specific type of coffee bean could come to the rescue. Increasing temperatures could make up to 50% of the land areas currently used to grow coffee unusable for the crop, which will not be able to withstand the heightened temperatures. *Coffea stenophylla* could help. This species is more suitable to higher temperatures, tolerating up to 6.8°C more heat than Arabica coffee plants, which is used for the vast majority of coffee that humans consume. This coffee, which was once widely traded, yields less than the two common varietals we rely on today. But it may be used more in the future, especially because it has a flavor similar to Arabica coffee.

Global consumption of fruits, vegetables, nuts and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%. A diet rich in plant-based foods and with fewer animal source foods confers both improved health and environmental benefits. Unfortunately, with current unsustainable methods of farming and worsening climate change, many of the staples we rely on today will be even more expensive and less accessible by 2050 than they already are. “Transformation to healthy diets by 2050 will require substantial dietary shifts. So innovations are much more needed in food to shape the future.

Symposium Lecture

Role of Biotechnology in Global Food Security and Nutrition

Prof. Nilantha Liyanage
Professor in Food Science and Technology, Department of Food Science and Technology, Faculty of Agriculture, University of Ruhuna

Biotechnology is an applied life science which basically the combination of biology and other different techniques to change or modify products for specific human use. Biotechnology plays a pivotal role in human welfare and has revolutionized mankind since its existence. It contributes much towards the human welfare and their health needs.

The world's population is more than three times larger than it was in the mid-twentieth century. The global human population reached 8.0 billion in mid-November 2022 from an estimated 2.5 billion people in 1950. The world population is projected to reach 8.5 billion in 2030, and to increase further to 9.7 billion in 2050 and 10.4 billion by 2100. (Data from the UNFPA Population Data Portal).

Due to the increase of human welfare, this dramatic population growth has been driven largely by increasing numbers of people surviving to reproductive age. However, this trend will have far-reaching implications for generations to come due to certain limitations of the resources unless expanding their existing potentials. Biotechnology is regarded as an ultimate tool to expand the boundaries where nature has decided.

Nutrition is a pivotal segment in human welfare. It is the process by which substances in food are transformed into body tissues and provide energy for the physical and mental activities of human life. Projections show that feeding a world population of over 9 billion people in 2050 would require raising overall food production by some 70% between 2005 and 2050 (FAO, 2009).

Globally, the rate of malnutrition has dropped during the past few decades. It was estimated that approximately 15 percent of people in the world suffered from malnutrition in 2000 and in 2019, the global rate of malnutrition was estimated to be approximately 9 percent. This is a significant reduction in a relatively short amount of time due to agriculture development. However, at present approximately 690 million people in the globe are estimated to suffer from undernutrition. (World population review, 2023)

In this review, it is expected to summarize the role of Biotechnology in global food security and human nutrition in the past and present.

1.Biotechnology for crop and yield improvements

The global population continues to rise, as does the probable reduced yields of major food crops due to the changing climate and several other reasons, thus making the development of genetically improved, stress-resilient crops a research priority.

In traditional plant breeding, new varieties are developed either by selecting plants with desirable characteristics or by combining qualities from two closely related plants through selective breeding. These features may for example be resistance to a particular pest or disease, or tolerance to climatic conditions. Traditional plant breeding has produced numerous highly successful new varieties of crops over the centuries. Green revolution began with the development of plant breeding techniques and the identification of dwarf and semi-dwarf genes in rice and wheat made possible the development of non-lodging cultivars with high yield in response to fertilization (Hedden, 2003). The adoption of the new cultivars combined with higher levels of fertilization resulted in dramatic yield increases in Southeast Asia (rice) and Mexico (wheat). Plant breeding involved in maize production in the US, where yields have increased by more than five-fold since 1930. These impressive yield increases have been preceded by the adoption of breeding innovations which, sequentially consisted of the selection within open-pollinated varieties, development of double and three-way hybrids, simple F1 hybrids, and GMO F1 hybrids (Hallauer and Carena, 2009). However, there were limitations in selective cross breeding which includes the masking effect of environment in the selections process and inclusion of unwanted traits which accompanied by the favourable traits usually make the breeding program unsuccessful or delayed (Araus et al., 2008).

Fortunately, during the last few decades many developments have taken place in molecular biology and genetic engineering. This has resulted in new tools and approaches for breeders that partially overcome the main limitations of genotype selection using exclusively phenotypic characterization. The development of a broad array of molecular markers has facilitated the identification of sources of variation and selection at early stages, for complex traits or that were phenotypically difficult to evaluate as time taken for productive stages. Also, the possibility of horizontal transfer of genes has resulted in genetically modified (GM) plants with new properties and characteristics. Despite the opposition of some sectors of the society and a skintight legal scrutiny (Cunningham, 2003), GM crops have proved that can lead to a dramatic improvement of yield and quality without adverse effects on the environment or human health (Fedoroff, 2010). Another research reported a yield comparison between conventional and improved pulse varieties; improved varieties showed a 40% increase of yield than the conventional varieties. (Miah et al, 2009) The convergence of low-cost genome sequencing with improved computational power and high-throughput molecular phenotyping technologies has accelerated the identification of genes underlying important agronomic traits relevant to food production and quality.

Biotechnology has played a significant role in improving human health by producing enriched nutrients in food products. The improved agronomic traits have largely focused on input traits, differentiated crops are more focused on grain quality or output traits. Classical breeding has produced a diverse range of differentiated crops such as canola vs. high erucic and glucosinolate containing rape; waxy and high amylose maize vs. yellow dent corn; basmati vs. long grain rice; durum wheat vs. regular wheat, pro-vitamin A enriched Golden rice vs regular rice, etc.

2.Animal Biotechnology for Nutrition and human welfare

Like the gradual crop improvements by selecting superior plant varieties, animal breeding programs has greatly contributed to the global food security. Moving further, Animal biotechnology also has reached significant milestones, such as transgenic animals (xenotransplantation, Embryo transplant, animal vaccines (biopharming), stem cell research, etc. The first attempts at creating transgenic animals were recorded in the early 1980s. Early methods involved injecting a DNA fragment with the desired insert sequence into mouse embryos. Although this achievement was a major advance in the field of genetics back then, the method had severe limitations such as high toxicity due to the off-target DNA inserts. Consequently, several alternative methods for creating transgenic animals surfaced. The genetic material of embryonic stem cells was modified in a targeted manner via homologous recombination using a template DNA. Then, these modified stem cells were injected into mice embryos. Over time, newer techniques, such as site-specific recombinases, ZFNs, and TALENS, improved the precision of editing specific genomic targets in animals. CRISPR (Clustered Regularly Interspersed Short Palindromic Repeats) is a family of DNA sequences found in the genomes of prokaryotic organisms such as bacteria and archaea. These sequences are derived from DNA

fragments of bacteriophages that had previously infected the prokaryote. They are used to detect and destroy DNA from similar bacteriophages during subsequent infections. Introduction of CRISPR-Cas9 technology was a remarkable milestone in the field of genetic engineering. As CRISPR enabled targeted genome editing in a simple, efficient, and economical manner, the process of creating transgenic animals became quicker. The list of CRISPR-modified transgenic animals now extends far beyond mice to many more species. Growth hormone gene engineered "aquAdvantage" Salmon fish was the first genetically engineered organism approved for consumption in United states in 2015. Raising these transgenic salmon requires fewer resources than normal salmon. The required weight gain is achieved in 18 months which is the half of the usual market time by contributing to the production of more sustainable food products. After salmon research, scientists used CRISPR to target genes encoding the proteins ovalbumin and ovomucoid, the common allergens in chicken eggs. Researchers hope to produce hypoallergenic eggs in the future using this method. In addition to that animal biotechnologists have successfully developed faster growth lean meat of swine, sheep, goat, and cattle using growth hormone factors as transgenic materials. High protein milk production has been achieved by incorporation of higher number of copies of casein genes into cattle genome. Disruption of lactoglobulin gene has created a low antigenic milk in cattle, human breast milk proteins are produced in cow's milk are some of the other successful nutritional achievements in animal biotechnology.(GeneWatch UK, 2002)

3.Microbial Biotechnology for human nutrition

Microbial food biotechnology research is critical for advances in food production, food safety, food security, value-added food products, functional foods, and human nutrition, as well as furthering fundamental research in biotechnology and the agricultural sciences.

l-glutathione (GSH) is a non-protein thiol compound with important biological properties and is widely used in pharmaceutical, food, cosmetic and health products. Systematic manipulation of glutathione metabolism in *Escherichia coli* for improved glutathione production was reported by Zang et al in 2016.

Leuconostoc is a hetero-fermentative lactic acid bacteria, and its importance is widely recognized in the dairy industry. However, due to limited genetic tools including plasmids for *Leuconostoc*, there has not been much extensive research on the genetics and engineering of *Leuconostoc* yet. However, Son *et al* in 2016 has Developed of a high-copy plasmid for enhanced production of recombinant proteins in *Leuconostoc citreum.* Thus, there is a big demand for high-copy-number plasmids for useful gene manipulation and overproduction of recombinant proteins in *Leuconostoc*.

Erythritol is a polyol that is used in the food and beverage industry. Due to its non-caloric and non-cariogenic properties, the popularity of this sweetener is increasing. Large scale production of erythritol is currently based on conversion of glucose by selected fungi. In a study, van der Woude *et al* in 2016 has described a biotechnological process to produce erythritol from light and CO_2, using engineered *Synechocystis* sp. PCC6803.

Summary:

In summary, biotechnology adds value across the system from plants, animals and microbes to farmer, industry, and consumer. Biotechnology can, and is, enhancing the quality of food in addition to improving the quantity of food. Biotechnology can improve the sustainability of production systems by requiring fewer inputs in far efficient manner. It helps to control pests, weeds and better protect the quality of water and land mass around us. Biotechnology can add health and vitality to humans. If we look at food production and nutrition in a more holistic way, biotechnology will be an important component of the system.

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Symposium 2: Re-imagining the Future of Child Nutrition

Plenary Lecture

Current Status and Way Forward in Child Nutrition

Snr. Prof. Pujitha Wickramasinghe
Senior Professor of Paediatrics, Faculty of Medicine, University of Colombo

Sri Lanka's despite being a Lower-middle income country (LMIC), has her health indices comparable to many developed economies. However, the transitions brought by the open economy moved Sri Lankans from a traditional indigenous starch-based unrefined diet to a fat, protein and sugar-rich, refined, processed food consuming society.

Since independence, undernutrition rates have been very high, and almost half of the under-five population had been suffering from underweight and stunting by 1975. Thereafter, a gradual decline in undernutrition was seen. But since the turn of the century, it has plateaued. Sri Lanka, while has improved many health indices has failed to improve on its undernutrition indices beyond this level. 2016 DHS survey showed that moderate acute malnutrition (MAM) to be 12.1% while sever acute malnutrition to be 3.0% in under five years and stunting 17.3%. Island wide survey done on children older than 6 months during last quarter of 2021, in the post-covid era but before the economic downturn, showed slight improvement in nutrition indices. The same report showed that in the 5 -9-year age group stunting was 7.1% and thinness 20.9%. Overweight 5.0% and obesity being 7.6%. In 10–17-year-old adolescents, 14% of stunting and 21.3% of thinness was recorded. Therefore, it could be seen that while undernutrition reduced and plateaued, over nutrition increased paving the way to change in disease pattern in the country. While anthropometry base parameters establish undernutrition, its effects on health and wellbeing have not been assessed.

Although nationally representative data does not exist on communicable disease risk in children in Sri Lanka, smaller studies confined to urban and suburban settings have shown a rise in NCD risk from younger age. Hypercholesterolemia, hypertriglyceridemia, low HDL-c, insulin resistance and dysglycaemia are some of the problems that are emerging among children. While many obese children have related metabolic abnormalities, metabolic syndrome could be seen approximately among a fifth of a population.

However, the current economic downturn has affected the nutritional status due to scarcity of food as well as reduced purchasing power due to increase in prices of food and reduced earning capacity of individuals. Effects are both immediate and long-term ranging from wasting in short term and poor neuro cognitive development, school performance and susceptibility to infections and stunting in the long term are emerging problems to be expected in near future if lasting solution to the nutrition crisis is not sought in time.

Growth Monitoring

Growth is the unique feature that differentiate children from adults. Growth charts assist parents and health care workers in guiding a child to achieve optimum growth. Appropriate growth references

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need to be identified, as individual health management and public health decisions would be based on these. Optimum growth is of paramount importance for educational and socio-cultural achievements. Nutritional status of children is determined by anthropometry based cutoff values. Deviated growth parameters from the designated 'normal' reflects nutritional status. A single stand-alone measurement value is meaningless and serial measurements plotted on an appropriate growth chart is important to obtain a proper insight to the growth of a child. Combining INTERGROWTH-21st data with the WHO growth standards provided a set of international standards for assessment of growth from conception to birth including preterm babies up to 18 years of age. In 2007, Sri Lanka adopted the new WHO charts (2006) for growth assessment of children 0- 5 years of life and in 2014 WHO 2007 standards for older children. In 2017, preterm charts developed by INTERGROWTH-21st, in the national growth monitoring programme.

Selection and application of growth references

References describe how children do grow, in contrast to growth standards that prescribe how children should grow. Growth references are prepared from the general population based on the presumption that growth occurs in the best possible way according to the conditions and availability of resources such as the nutritional, health and socio-economic status. Although international charts help to compare between different countries, socio-economic and ethnic groups, they could distort the true picture of prevalence of stunting, wasting, underweight and overweight/ obesity in many countries, especially in developing countries such as Sri Lanka.

Factors affecting growth

Growth is a function of many factors. It is not only nutrition, but genetic inheritance, hormones, illnesses, and even social setting. Social-Economical-Political-Emotional (SEPE) factors have closer interaction with biology of growth. Higher SEPE community are taller while lower SEPE community are shorter. Stunting is not a synonym with malnutrition. Thus, growth references must not be used to define malnutrition directly without out validating to a local population. Health depends on Body composition to a great extent. However, anthropometry cutoff does not reflect healthy body compositon accurately. Many could have apparently normal weights but could have been made by excess body fat. Therefore, although weight shows comparable values, they could be having different body compositions.

Almost all growth parameter from lower middle-income countries showed to be lower than the WHO 2006 standard. This cast the doubt whether those even in the highest quintile of socioeconomic status of a country could adopt growth charts developed on other countries or ethnic groups. Use of inappropriate chats could lead to overreporting of undernutrition while underreporting over nutrition. The danger of this is that the undernourished gets over treated and over nourished go undetected till their metabolic profiles worsens. Therefore development of growth charts specific to the population would be the most prudent action although it could be a costly exercise.

Anthropometry charts are mainly based on population distribution of a parameter, and it would not always depict the morbidity and categorizing them on a single parameter could be disadvantageous to an individual. This is especially true for children categorized as undernourished based on anthropometry, but who are otherwise quite active and healthy with good school performance. This clearly shows that in all stages of growth assessment one size tool does not fit all.

Way forward is to provide a secure conducive environment with food security for children to grow optimally. Following need to be addressed if we think of improvement of child wellbeing.

It is important to strengthen growth monitoring and feeding in order to detect faltering early in life and correct it. Commonest faltering is seen between 4 to 6 months, due to inadequacy of calories in breast milk. Early correction through timely introduction of complimentary feeds is important to maintain optimum growth as life in first 1000 days plays a crucial role in later health.

Growth references used in Sri Lanka need to be locally validated before they are being used. Growth charts developed in India, China, Indonesia, and Saudi Arabia have shown that Asian children have similar growth patterns while all of them differ from Caucasian children of European origin. Further in the 5-15 year age group also it has been shown that the distribution of Sri Lankan references are about 1 SD below the level of WHO references. This clearly shows that Sri Lankan children also need to have their own growth charts or validate a suitable regional chart.

Improving the average birth weight is one of the most important factors to improve child growth. It is imperative that a female embarks on a pregnancy with a sound nutritional and health status. Low height and wasting are risk factors for low birth weight. Improving adolescent health is a key.

Pre-pregnancy counselling is an important aspect and through registration of eligible couples programmed this could be achieved. During this period optimizing the nutritional status of the female is important.

Food production and distribution in Sri Lanka throughout the year should not be a problem. However, optimum utilization of soil and weather, inland water tanks, distribution of agricultural produce is of paramount importance. Adding of extra overheads and profits has made food more expensive.

Minimizing the pre- and post-harvest losses plays an important step in ensuring food security. The traditional foods and preservative practices have disappeared in the modern world.

Food taboos and mis-concepts could contribute to child malnutrition and Sri Lanka could be identified as one country with many food taboos.

Gut microbiota has shown to play a significant role in growth and health of children. Its quite clear that the food we take make the gut microbiome and it is a signature of the local patterns of diet. The concept ‘microbiota directed food’ has shown to improve child growth and it would be enhanced through locally available food rather than food brough from outside the geographical locality of living of the child.

Socio Economical Political Emotion (SEPE) factors are aspects beyond nutrition would affect the growth of a child. Stability in SEPE with a secure environment with minimum uncertainty.

We, who care for health, have a great responsibility in harnessing the optimum growth potential in children thus reducing malnutrition. Therefore, we need to empower all stakeholders involved directly and indirectly in this process and bring conducive changes within the existing system.

Symposium Lecture

Hidden Hunger in Children

Prof. T. Kudagammana
Professor of Pediatrics, Faculty of Medicine, University of Peradeniya

Nutrients that human needs are of two main categories. Macronutrients -mainly protein and energy – are needed in big quantities. Micronutrients are those needed in small quantities and include vitamins, minerals and trace elements. Dietary intake of micronutrients is essential because they are not synthesized by the body. Deficiency leads to decreased immunity, impaired cognitive performance, stunted growth, and increased morbidity and mortality among many other problems. MND also has implications on economic development and productivity of the country.

Micronutrient deficiencies (MND) are progressive and cannot be identified clinically until they are in their late stages; because of that these are referred to as "hidden hunger". Deficiency of iron, vitamin A and iodine together affect around 30% of the world's population. It is estimated that more than 2 billion have anaemia, around 2 billion have iodine deficiency and around 250 million preschool children have vitamin A deficiency. It is estimated that 7.3% of global disease burden are caused by MND. Iron deficiency anaemia (IDA), vitamin A deficiency and iodine deficiency result in 25 million, 18 million and 2.5 million deaths respectively. MND, especially zinc and vitamin A deficiency (VAD), are found to contribute to 2–12% of the total disability-adjusted life years (DALYs) in high-burden countries.

Deficiencies in iron, vitamin A and iodine are the most common MMN deficiencies around the world, particularly in children and pregnant women. Low- and middle-income counties bear the disproportionate burden of micronutrient deficiencies. The co-existence of multiple deficiencies, as well as MND coupled with protein and/or energy malnutrition, is also common, resulting in devastating consequences.

Substantial demographic and socioeconomic changes in Sri Lanka have created significant health and nutrition challenges. The nutrition transition in Sri Lanka is characterized by replacement of vegetable-based foods with animal-based foods and increased consumption of sugar, salt, and alcohol, surpassing recommended intake. In addition, the consumption of fruits, vegetables, and milk products is also low. Although considerable evidence is available regarding macronutrient deficiency in Sri Lanka, there is little published information regarding MND.

Iron deficiency (ID) is the most prevalent MND and the main cause of anaemia worldwide, with ID anemia (IDA)representing the advanced stage of ID. Although ID does not progress to anemia in all cases, anemia is often misinterpreted as an indicator of ID. The burden of ID is largely concentrated in Africa and South Asia, contributing to 75% and 65% of global mortality burden and DAILYs lost, respectively.

ID has detrimental effects on the cognitive and physical development of children, the productivity and physical performance of adults and on pregnancy outcomes. It also causes impaired growth, cognition, behavior, immunity, hormone balance, performance, and work capacity.

The risk of ID and IDA during the second six months of life is particularly high due to the combined effect of increased demands, rapid development, and depleted prenatal iron stores. However, according to results of the national micronutrient survey in Sri Lanka, the highest prevalence of ID was seen in children aged 12–23 months. Increased iron demands during the growth spurt make adolescents more vulnerable to ID.

Iodine deficiency (IDD) is fortunately overcome with effective intervention programme. The national IDD survey conducted in 1986 found a total prevalence of goiter among school children of 18.2%. Consequently, the USI program was implemented in Sri Lanka in 1995. The current TGR in Sri Lanka is well below the public health cut-off of 5%, and the median urinary iodine concentrations in all nationwide studies were above the acceptable level of 100 g/L indicating optimal iodine status and thyroid health among school-age children.

Zinc is an essential trace mineral for cellular metabolism, immune function, linear growth, and neurobehavioral development. Its role in cell division, enzyme function, and protein and DNA synthesis, zinc is a critical determinant of normal pregnancy outcomes and child growth.

Zinc deficiency increases the incidence, morbidity, and mortality of diarrhea, acute respiratory infections, and malaria. Unlike iron, there is no long-term storage system for zinc in the human body, and therefore consistent dietary intake is essential. Major dietary sources of absorbable zinc are animal-based foods and seafood. Thus, zinc deficiency may be common in populations consuming a cereal-based diet with low levels of food from animal sources. According to 2012 estimations, 17.3% of the global population and 30% of the population in South Asia is at risk of inadequate intake of zinc.

A lack of nationally representative data hampers validation of the magnitude of other mineral deficiencies in Sri Lanka.

Vitamin A, in addition to being important for vision health, vitamin A has roles in reproduction, cellular growth and differentiation, immune function, and maintenance of epithelial cell integrity. Hence, Vitamin A deficiency (VAD) can have several negative health consequences, including childhood blindness, xeropthalmia, impaired growth and development, and increased rates of infections, morbidity, and mortality.

In the national survey 2006 VAD (serum retinol level < 20µg/L) was observed in 29.3% children aged 6-59 months, whereas severe VAD (serum retinol level < 10µg/L) was found in 2.3%. Prevalence of VAD among children between 1-5 years was 29.6%. Average consumption of vitamin A rich food items has not yet reached the acceptable level of 70% which indicates VAD is still a public health problem in this survey population.

The National strategy to control VAD as a public health problem was developed in year 2000 in collaboration with UNICEF.

As a result, Vitamin A mega dose supplementation programme was initiated in year 2001 for children between 6 months to 5 years and primary schoolchildren providing 5 doses of Vitamin A (100,000IU) at the age of 9 months, 18 months, 5 years and 9 years with the postpartum supplementation of 200,000IU Vitamin A mega dose for all mothers within 4 weeks of delivery.

According to the recommendations of the international vitamin A consultation group, when 15% of children aged 1–5 years in a given population have serum retinol concentrations < 20 g/L, the community has a VAD of public health significance.

Vitamin B12 is found only in foods of animal origin because it is synthesized only by microorganisms. The most common cause for poor B12 status is low dietary intake of the vitamin (i.e. a low intake of foods of animal origin) and malabsorption.

Thus far, only few studies have investigated serum Vitamin B12 levels, with low serum Vitamin B12 (<150 pg/mL) levels being found in only 10 of 613 subjects. The simultaneous occurrence of multiple MND is more common than single MND occurring in isolation. Available data suggest a higher prevalence of multiple MND among children and adolescents in Sri Lanka. Of a cohort of preschool children in Galle district, 62% were found to have multiple MND. In the sample, 38.3%, 17.7%, and 6% of children had two, three, or four or more MND simultaneously, and only 7.3% did not have any type of MND studied.

Overcoming MMN deficiency needs nutrition education programmes and interventional programmes. Thriposha is a precooked 'ready-to-eat' cereal legume-based food. It provides energy, protein and micronutrients. Thriposha provides the full vitamin A requirements of a child of 3 years (400 µg retinol) with 10 gram of reference protein, 320 kilo calories of energy and all the required minerals and vitamins by 100g per day. MMN supplementation programme has been started to overcome MMN deficiencies in children which needs strengthening to achieve the potential.

Many of these deficiencies are preventable through nutrition education and consumption of a healthy diet containing diverse foods, as well as food fortification and supplementation, where needed. These programmes have made great strides in reducing micronutrient deficiencies in recent decades but more efforts are needed.

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Symposium Lecture

Healthy Eating Interventions to Promote Dietary Behaviors of Young Population

Dr. Fathima Sirasa
Senior Lecturer, Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka

'We are guilty of neglect if we let our children become malnourish.'

Neglecting the children, the foundation of life would be our worst crime, as we cannot respond him/her tomorrow, it has to be done today.

According to the UNICEF/WHO/World Bank Group – Joint Child Malnutrition Estimates 2021, globally, 149 million children were stunted, 45 million were wasted and 39 million were overweighed. Middle income countries bear the majority of this burden. During last 20 years, the prevalence of stunting was declining too slowly, whereas the prevalence of overweight has remained unchanged or showed a slight rise. Sri Lanka is a lower middle-income country showed a similar pattern to the global prevalence for undernutrition prevalence, but the country exhibited a 43% increase in overweight and obesity prevalence among children under 5 years old during last decade (2006 – 2016). This health threat need to be intervened and the prevention to the path can be targeted as dietary modifications, a healthy environment and safe physical activity for young children.

This session is about healthy eating behavior interventions for young children. Selecting young age or early childhood to make a dietary behavior change is perfect as this age is suggested as a critical period in the formation of food preferences. Because, at this age their behavioural patterns are still developing and dietary habits established in early childhood will persist through to adulthood.

Eating behavior is a dynamic process, influenced by multiple factors with interactions at multiple levels. Bronfenbrenner's Ecological System Theory explains the interplay of multi-level factors on development of food choices in a child. This theoretical model comprises 'layers' of environments including microsystems, mesosystem, exosystem and macrosystem around a child's individual characteristics (sex, age, genetics). Microsystem is the closest setting in which a child interacts, such as family (parents, siblings), preschool (teachers, peers), day care centers (caregivers, peers). The mesosystem consists of the relationships that exist between the various microsystems, such as the relationships that parents have with a child's siblings and or teachers. The exosystem constitutes the broader environments in which the child doesn't usually interact directly, but which can still affect the child. These include, for example, the decisions made by school boards, the opportunities present at the parents' workplaces, and the influence of mass media. The macrosystem is the largest, formed of broad societal settings which include shared culture, history, or customs, the system of laws, and the economic system. According to literature, Family and pre-school environments are the key microsystems in shaping the eating behavior.

Exploration of such contextual factors were mostly conducted in high income countries and to the best of our knowledge, only three studies have been conducted in middle-income countries, including Argentina, Mexico and Sri Lanka.

In Sri Lankan study, 13 focus groups were conducted and found that the food preference of the child was the core driving factor followed by family income, nutritional knowledge of the family, maternal control of food choices and household food preparation facilities.
Based on the literature, several reviews were conducted to identify effective intervention types and characteristic of effective interventions. Here I am sharing three reviews by Mikkelsen et al., (2014);

Murimi et al., (2018) and Matwiejczyk et al., (2018). According to Mikkelsen et al., (2014), existing interventions conducted for young children can be classified in to three main categories.

Single intervention studies

- involve the modification of a single factor in the environment to promote healthy eating. This type of intervention includes serving either novel or non-preferred vegetables to children or using peer-models to check the effect on vegetable preferences as well as intake.

Educational intervention studies

- educate the children to improve their knowledge of healthy eating

Multi-component intervention studies

- included more than one strategy to influence healthy eating such as combinations of two or more of education program (children, newsletters for parents), food exposure (having children participate in growing their own vegetables), environment modification (making fresh water, fruit, and in some cases vegetables, available; food modifications in the school canteen; and healthy school policies), family engagement (health fair, cooking and eating meals together with children)

Single component interventions showed positive as well as null findings. Educational interventions delivered significant positive outcomes. Multi-component interventions mostly target the micro system of the child to support the healthy eating especially the family and pre-school setting. Either educational intervention studies or multi-component focused interventions showed significant positive outcomes in the healthy eating behaviour of preschool children compared to single intervention studies (Mikkelsen et al., 2014).

Another review summarized that the Interventions in children (aged 2 to 19 years) with a multicomponent approach (engaged parents), using age-appropriate activities and of adequate duration ($\geq$ 6 months), assured fidelity by training teachers or recruiting trained experts to deliver the intervention were more likely to succeed (Murimi et al., 2018). Similar findings were emphasized in an umbrella review which found that interventions with multicomponent (addressed physical activity and diet, targeted individual-level and environmental-level determinants, and engaged parents) and researcher/external expert led intervention delivery were effective in promoting healthy eating in children aged 2-5 years (Matwiejczyk et al., 2018). Therefore, multicomponent interventions with age-appropriate activities need to be the primary focus in effective eating interventions.

With that evidence a Sri Lankan study was conducted to evaluate the effectiveness of a multicomponent intervention (MCI) on children's dietary diversity and its impact pathway components of children's food knowledge and healthy food preferences. A 6-week cluster randomised controlled trial with a MCI consisting of child nutrition education plus family engagement through parental nutrition education, meal preparation and tasting was compared with two groups: single component intervention (SCI) of child nutrition education, and control, conducted during February to July 2018. Preschool centres were randomly assigned to one of the three arms.

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Children's food knowledge, healthy food preferences and dietary diversity scores were collected. Intervention effects were analysed using a pre-post analysis and a difference-in-difference model.

The study found that the MCI significantly increased children's food knowledge and healthy food preferences scores by 3·76 and 2·79 ($P < 0·001$), respectively, but not the dietary diversity score ($P = 0·603$), compared with the control arm. Relative to SCI, MCI significantly improved children's food knowledge score by 1·10 ($P < 0·001$). They concluded that the improved food knowledge and preferences require a positive food environment and time to develop into healthy eating behaviours. Additionally, this could be due to not having a delayed assessment of post intervention to check for sustained effects.

Therefore, future research required to incorporate the contextual roles of the home and general food environments along with the factors influencing the development of eating behavior to more completely understand food choices of children. Also, the duration of the intervention need to be extended with adding a third data collection point (around 6 months) post-intervention to examine whether the improved knowledge and preferences are sustained at in intervention group.

Symposium 3: Healthy Lifestyle and Non- Communicable Diseases
Plenary Lecture

Dietary and Behavioural Modifications to Combat Cardiovascular Diseases

Prof. Namal Wijesinghe
Professor of Medicine, Dean – Faculty of Medicine, General Sir John Kotelawala Defence University

Non-communicable diseases (NCDs) are diseases that are non-contagious form person to person and can be caused by a combination of factors including behavioural, physiological, environmental and genetic factors. Common NCDs include diabetes, hypertension, cardiovascular diseases (e.g., myocardial infarctions and cerebrovascular accidents), cancers and chronic respiratory disease (e.g., bronchial asthma and chronic obstructive pulmonary diseases). Many modifiable risk factors contributed to development of these NCDs. They include unhealthy dietary patterns, physical inactivity and lack of exercises, tobacco use and excessive alcohol intake.

Diet influences the cardiovascular risk by both their effect on cardiovascular risk factors such as diabetes, hypertension, hypercholesterolemia and obesity and through their direct effect. Intake of saturated fatty acids should be reduced to less than 10% of total energy intake by replacing it with polyunsaturated fatty acids. Trans fatty acids are a type of saturated fatty acids that forms during industrial food processing. Trans fats increase total cholesterol and reduces HDL cholesterol level. It is recommended to reduce trans fats to < 1% of total energy intake.

The Dietary Approaches to Stop Hypertension (DASH) trial demonstrated the association between sodium restriction and blood pressure reduction. Almost 80% of the total salt comes from processed food while remaining is added during cooking or at the dining table. It is recommended to limit salt intake to < 5 g per day. Increasing potassium intake contributes to lower blood pressure. Higher consumption of fruits and vegetables, which are high in potassium should be considered in addition to salt restriction to control high blood pressure.

Regular consumption of sugar and sugar-sweetened soft drinks is associated with obesity, diabetes and metabolic syndrome. The WHO recommends to limit the energy from sugar and sugar-sweetened soft drinks to < 10% of daily total energy intake.

Overweight and obesity are associated with increase in blood pressure, insulin resistance, dyslipidaemia, albuminuria and prothrombotic state. Both overweight and obesity are associated with development of diabetes, coronary artery disease, heart failure, atrial fibrillation, stroke, cardiovascular mortality and all-cause mortality. Therefore, weight loss is recommended for all overweight and obese individuals for cardiovascular risk reduction.

Body mass index (BMI) is used extensively to identify overweight and obese men and women. Individuals with BMI of 25-29.9 kg/m2 are categorized as overweight while BMI > 30 kg/m2 are categorized as obese. All-cause mortality is lowest with BMI of 20-25 kg/m2. However, maintaining a BMI between 20-23 kg /m2 is recommended for Sri Lankan population considering the higher cardiovascular risk among South Asians.
The pattern of fat distribution is especially important for South Asians as their intra-abdominal fat deposition is associated with higher cardiovascular risk. Waist circumference and waist to hip ratio (WHR) are used to identify individuals with abdominal obesity. For South Asian populations, men with waist circumference > 90 cm and WHR > 0.9 and women with waist circumference > 80 cm and WHR > 0.8 are recommended weight loss to reduce cardiovascular risk.
Life style interventions, behavioural modifications, regular exercises and calorie restriction are of paramount importance for weight loss. Smoking affects vascular endothelial inflammation, oxidative processes, platelet functions, fibrinolytic mechanisms, lipid oxidation and vasomotor functions. These mechanisms enhance atherosclerotic process and prothrombotic phenomena increasing the cardiovascular risk and cardiac events.

Smoking cessation is the most cost-effective intervention for cardiovascular risk reduction. This risk is associated with the degree of smoking with no lower limit for its deleterious effects. A long-standing smoker has a 50% risk of dying from his smoking habit and average loss of 10 years of his life. The 10-year risk of mortality is approximately double in smokers compared to non-smokers.

Passive smoking or environmental tobacco smoking is also associated with increased cardiovascular risk. The cardiovascular risk increases by 30% if an individual is exposed to passive smoking.

The risk of cardiovascular events is reduced almost close to the level of a non-smoker within 10-15 years of abstinence from smoking. There is no age limit to achieve the benefit of smoking cessation. Passive smoking should also be avoided.

Regular physical activities and exercises help to prevent and control many cardiovascular risk factors including hypertension, diabetes, LDL cholesterol and non-HDL cholesterol. Regular physical activities and exercises also reduce cardiovascular mortality and all-cause mortality in healthy individuals and patients with cardiovascular diseases.

Aerobic physical activities and exercises have a dose-response effect on reduction and control of cardiovascular diseases. They include brisk walking, jogging, swimming, cycling, dancing, gardening and daily household and occupational activities. Aerobic physical activities and exercises of moderate intensity for at least 150 minutes or vigorous intensity for at least 75 minutes per week is recommended for all healthy men and women for cardiovascular risk reduction. The frequency of each session should be at least 5 times a week but preferably every day. The prescription for physical activity and exercises should be tailored to individuals to determine intensity, duration and frequency accordingly. Individuals who can do more exercises should be encouraged to do more exercises to gain additional benefits while, individuals who cannot perform minimum recommended level of physical activity and exercises should be encouraged to do some physical activities or exercises as even less than minimum recommended level of activities can be beneficial to reduce their cardiovascular risk.

NCD burden in 21st Century: Evidence based management.

Dr (Ms.) Daminda Attanayake
Sports and Exercise Physician, Head of the Rehabilitation Unit at Institute of Sports Medicine

The acceleration non-communicable diseases (NCD) are carried forward burden from the 20th century to 21st. NCD's represent a group of major chronic diseases: cardiovascular diseases (CVDs), diabetes, stroke, cancers, and chronic obstructive pulmonary disease (COPD). Furthermore, NCD has several risk factors needs effective strategies to modify.

Behavioral risk factors such as unhealthy diet (diet rich in salt, sugar, and fat and low in fruit and vegetable intake), physical inactivity (sedentary lifestyle), tobacco consumption (tobacco smoking and use of non-smoking forms of tobacco), and alcohol use have been shown to increase the risk of several NCDs.

The need of urgently taken measures based on evidence need to be identified and implemented. It is important that outcome of the measures identified by scientists are dose -responsive, easy to follow at any time or any age group and they are effective in prevention the disease and its complications with minimum side effects. In this presentation, evidence of such a measure will be discussed with most recent global evidence.

Symposium Lecture

Physical Activity is a Medicine for Non-Communicable Diseases

Dr. H.R.L.K. Hettige
Acting Consultant in Sport and Exercise Medicine, Lady Ridgeway Hospital

'If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health' - Hippocrates.

Human species evolved to perform and endure habitual physical activity. Following the technological advancement, humans' sedentary behaviour leads to lack of physical activity, resulting in devastating physiological and clinical consequences.

Non-communicable diseases are collectively accountable for 74 percent of deaths worldwide. Out of these, 86 percent deaths are premature deaths. NCD causes huge financial loss to the society by spending on healthcare cost (Average 2 trillion US dollars per year) and indirectly contributing to productivity losses (75 Billion US dollars per year). Apart from valuation by cost, it restricts quality of life too. In 2021, loss of 36 million of DALY (disability adjusted life years) has been identified.

Increasing in morbidity and chronic disability caused by NCDs, is an alarming proportion. Use of tobacco, alcohol consumption, unhealthy dietary practices and physical inactivity are the leading behavioural risk factors. Physical activity has been identified as the fourth leading risk factor for global mortality. In Sri Lanka STEP survey done in 2008 reveals that only 22.5 percent of males and 38.5 percent of females undertake minimum level of recommended physical activity. The National multi-sectoral action plan for prevention and control of NCD aims to achieve 10 percent relative reduction in prevalence of insufficient physical activity by the year 2025. Physical activity defined as 'any voluntary bodily movement produce by skeletal muscles that requires energy expenditure'. Exercise is a sub-set of physical activity defined as planned, structured, repetitive and objective improvement or maintenance of physical activity.

WHO has recommended to engage in moderate intensity for 150 minutes of cardiorespiratory activity per week, which should include resistance exercises of 2-3 day per week plus coordination and balancing exercises. Physical activity has a strong relation with primary and secondary prevention of non-communicable diseases. Physical activity has strong health benefits in prevention of cardio-vascular, neurological, endocrine, oncology and psychological disorders.

Worldwide various organizations have arrived in the conclusion that physical activity / exercises as a medicine for non-communicable disease as well as for healthy individuals. Properties of the drugs are high affinity towards the target, selectivity to the target organ, high bioavailability and low toxicity. Out of these, except for selectivity, other properties are closely tallying with physical activity.

Similar to medicine we prescribe, it is needed to consider indications, contraindications, type, frequency, duration and interactions. Physical activity challenges the body by altering complex physiological changes and adaptation via specific metabolic, physiological and biomechanical processes. These are accomplished by shifting of gene transcription and protein translation. These changes happen through catecholamine hormone system and neuroendocrine system activation.
Chronic disease conditions cause to reduce mitochondrial levels, which leads to reduce VO_2 max levels. Cornerstone of exercise response is the mitochondrial biosynthesis in skeletal, liver, adipose and kidney tissues. ATP/ADP ratio, intracellular calcium, free radical oxygen molecule act as signaling in this process. This leads to efficient energy utilization and improving overall endurance capacity. According to studies, VO_2 max is a predictor of morbidity and mortality.

Effect of physical activity on the body, is transient due to short half-life of transcript proteins, transient increase in gene expression during recovery period and reduce expression during the activity. Physical activity gives cardio-protection by increasing intra-cellular nitric-oxide by upregulating endothelial nitric oxide synthase. Nitric oxide lowers the peripheral resistance and increase vascular perfusion. Physical activity increases expression of GLUT-4 molecule in skeletal muscle reducing glucose levels. During exercises natural killer cells, myokines levels are increasing which help to reduce inflammation and tumor metastasis giving protection for cancer patient.

Physical activity gives neurological support by increasing brain derived neurotrophic factors (BDNF) and Insulin like growth factor (IGF-1). These molecules reduce brain atrophy and neurodegenerative diseases. Physical activity reduces cerebral choline level, the compound which increase neural loss. Psychological disorders are prevented by augmenting endorphin secretion and proper function of hypothalamic pituitary adrenal axis reactivity.

Even with all these benefits, there are risks associated with physical activity. Hence, prescribing exercises need to offset the risk vs benefits. Risks are mainly happening in musculoskeletal system, cardiac system, respiratory system and acid-base balance. Specially, with the increasing of age, genetics, sedentary lifestyle and disease itself changes body internal environment by altering in acid base balance, electrolyte fluctuation and hormone system imbalances.

Considering these facts, it is recommended to take opinions from treating clinicians as well as qualified sport and exercise medicine clinicians, prior to start exercise programme. modifications needed according to the disease, severity and other factors.

In Sri Lankan context, Sri Lanka Sports medicine association (SLSMA), in collaboration with NCD unit of the Ministry of Health and Institute of Sports and Exercise Medicine have taken steps to achieved WHO goals of achieving the reduction of physical inactivity and premature mortality by the year 2025. This includes organizing Training of Trainer (TOT) programmes covering most of the districts, developing physical activity recommendation guidelines to healthy and people with NCD's.

To reduce physical inactivity, we need to address the individual level as well as the community level. Various government and private organization need to work together to achieve these targets.

Symposium Lecture

Healthy lifestyles choices can overcome the genetic risk of obesity.

Prof Vimal Karani S
Professor in Nutrigenetics and Nutrigenomics, Deputy Director of the Institute for Food, Nutrition, and Health, Department of Food and Nutritional Sciences,
University of Reading, Reading, UK

The ability of Nutrigenetics to determine what nutrients will produce the desired impact on metabolic balance (as influenced by individual genetic make-up) is at the core of Precision Nutrition. Nutrigenetics has highlighted the complexity of gene-nutrient interactions, but it offers opportunities to re-evaluate criteria used to set dietary guidelines and the contribution of genetic variation to optimal nutrition for individuals from different ethnic groups. Non-communicable diseases (NCDs) such as obesity and diabetes are heritable traits that arise from the interactions between multiple genes and dietary factors. Although studies in developed countries have examined these interactions extensively, there are limited studies in lower middle-income countries (LMICs). To address this missing gap in nutrition science in LMICs, a large-scale collaborative project called GeNuIne (Gene-Nutrient Interactions) Collaboration that aims to implement precision nutrition strategies based on the evidence from nutrigenetic and nutrigenomic studies using cohorts from various ethnic groups has been initiated. In this large-scale collaborative study, gene-nutrient interactions on NCDs across multiple ethnic populations from West Africa, North Africa, South Asia, Southeast Asia, West Asia, South America, and Middle East are being examined. A genetic risk score analysis was used to examine the combined effect of several genetic variations on NCD-related outcomes. While diets high in saturated fatty acids have been shown to increase the genetic risk of obesity in African and Western populations, diets high in carbohydrates and animal proteins were found to increase the genetic risk in South Asians, Southeast Asians, and West Asian populations. Furthermore, in Sri Lankan, Indonesian and Brazilian populations, those carrying a high genetic risk for B12 deficiency had an increased risk of metabolic diseases under the influence of dietary protein, fibre, and carbohydrate intakes, respectively; however, in South Asian, genetically instrumented metabolic disease risk showed a significant association with low vitamin B12 status. In summary, findings from GeNuIne Collaboration highlight the existence of genetic heterogeneity in gene–diet interactions across ethnically diverse populations, which further implicates the significance of precision nutrition approaches for the prevention and management of NCDs such as obesity and diabetes. If these interactions between genetic variations and nutritional requirements are better understood in various ethnic groups, dietary recommendations could be personalized according to genotype to ultimately promote health and reduce disease risk.

Symposium Lecture

Fruit and Vegetables for Sustainable Healthy Diets (FRESH)

Dr. Deanna Olney
Senior Research Fellow, International Food Policy Research Institute, USA

Poor diets are a primary cause of malnutrition and the leading cause of diseases worldwide. Improving diets, including increasing fruit and vegetable intake, could save one in five lives lost annually. Micronutrients and dietary fiber are essential for health; micronutrients obtained from fruit and vegetables have a lower environmental footprint than from other foods, making fruit and vegetables essential to healthy and sustainable diets. Globally, fruit and vegetable intake is far below recommended levels, however, the extent and nature of the problem is poorly understood due to insufficient dietary data, especially in low- and middle-income countries.

Increasing fruit and vegetable intake will require starting with consumers, understanding dietary patterns, and addressing desirability, accessibility, affordability, and availability barriers through cost-effective solutions. Solutions must take a holistic end-to-end approach that starts from intake and works back through the food system to improve accessibility of fruits and vegetables and increase year-round supply of a diverse range of safe, affordable, nutrient-dense vegetables.

With coordination among CGIAR centers and other partners, the Fruit and Vegetables for Sustainable Healthy Diets initiative (FRESH) aims to use an end-to-end approach working across the food system to increase fruit and vegetable intake, improve diet quality, nutrition and health while also improving livelihoods, empowering women and youth and mitigating negative environmental impacts. For the first three-year phase FRESH will be working in four or five focal countries, one of which is Sri Lanka.

Working across the food system the FRESH Initiative aims to achieve the following outcomes over the next 2-3 years:

1. Key actors from government, multilateral organizations, NGOs and academia in the 4 focus countries are actively engaged in designing and testing behavioral interventions targeted to women or youth to increase F&V intake
2. At least 10,000 individuals (e.g., students, academics, government and multilateral organizations and NGO stakeholders) from across sectors access the Web-based F&V Knowledge Hub as a resource for F&V learning, research and innovations
3. 10,000 farmers (at least 5,000 of whom are women) adopt improved climate-resilient vegetable cultivars across 4 focus countries
4. 10,000 farmers (at least 5,000 of whom are women) adopt safe and sustainable vegetable production practices (e.g. use of integrated pest management (IPM) across 4 focus countries
5. Private sector partners actively engaged in co-designing and piloting innovations are ready to scale at least 4 innovations to reduce post-harvest losses and/or improve food safety

6. Key actors from government, multilateral organizations (e.g., WFP), NGOs and academia (e.g. University of Peradeniya) in 3 of the focus countries are actively engaged in designing and testing interventions to increase the accessibility and affordability of F&V especially for poor and otherwise marginalized populations.
7. Key actors at national level (e.g., Agriculture, Finance or Health Ministers) prioritize F&Vs and incorporate specific actions aimed at increasing intake, production, food safety and/or equity within the F&V sector into national-level policies, laws or regulations.

In this talk, the overall vision for the FRESH Initiative will be presented along with some of the key activities that are planned to be implemented in Sri Lanka in the coming year.

Symposium Lecture

Nudging for Good: Real-time AI-driven Diagnostics and Behavior Change to Improve Adolescents' Diets and Nutrition

Dr. Aulo Gelli
Research Fellow, International Food Policy Research Institute, USA

Attention to nutrition during all phases of child and adolescent development is necessary to ensure that children can achieve their developmental potential. Low-quality diets during adolescence contribute to deficiencies that affect brain structure and function across the lifespan. In parallel, traditional methods for dietary assessment rely on self-reports that are resource intensive and lack accuracy with regards to portion size estimation. Existing technology assisted dietary assessment tools are constrained by lack of validity testing and feasibility of use in low- and middle-income countries.
Nudging for Good (NFG) is an innovative project aimed at developing, validating, and examining the feasibility of using mobile Artificial Intelligence (AI)-based technology to improve adolescent girls' diets in urban Ghana and Vietnam. The goal of this project was to generate evidence on the feasibility of improving the diets of adolescent girls using AI-enabled mobile technologies in Ghana and Vietnam. NFG involves a new interdisciplinary collaboration between the International Food Policy Research Institute (IFPRI), Penn State/FAO, the University of Ghana, the Thai Nguyen National Hospital, the Thai Nguyen University of Pharmacy and Medicine, and the National Institute of Nutrition (NIN) in Vietnam. In this paper we provide an overview of the NFG project including results on the validation and feasibility studies of FRANI (Food Recognition Assistance and Nudging Insights), the new mobile-phone based app for dietary assessment.

ABSTRACTS OF ORAL PRESENTATIONS

Food and nutrition behaviours, perceptions and beliefs of high-performance athletes in national pool of Sri Lanka

H.A.M.U. Weerasooriya [1], H.P.T.D. Wikcramarathna[1], D. Senanayake [2], U.N.J. Dahanayaka[2], A. Chandrasekara[1] and K.D.R.R. Silva[1]

Meeting energy and nutrient needs is a priority for athletes to achieve peak performance. However, athletes do not always make healthy food choices or have the best food options available to them. Therefore, it is vital to identify the behaviours, perceptions, and beliefs (BPBs) related to food and nutrition among athletes in Sri Lanka. The objective of this study was to determine the key nutrition-related BPBs of high-performance athletes in the Sri Lankan national athletic pool. An Interviewer-administered and previously validated questionnaire-based survey was conducted among a total of 40 athletes who were in the national pool of high performance, through telephone interviews. Data was descriptively analysed. Results showed that "improving the performance" (85%) was the major food choice determinant followed by "good quality/price ratio" (70%), "controlling weight" (67%), and "brand names of the food" (55%). The respondents had a perception that "large quantity of dietary protein consumption is essential to provide energy to the exercising muscles" (60%). Nearly 80% of them believed that proper hydration is important for their performance. About 40% of athletes did not show awareness of the importance of having "peri-workout supplementation" (pre, during, and post-event meals), whereas the majority of people did not properly identify the specific functions of supplements. Nutritional advice was sought by 75% of athletes from their coaches, 60% from medical doctors, and 50% from nutritionists. Around 93% of athletes used dietary supplements. Vitamins (83%), minerals (70%), branched-chain amino acid (68%), whey protein (60%), fish oil (55%), and creatine (53%) were most common. In conclusion, it appears that athletes are not aware of objective recommendations for protein intake and may perceive their needs to be excessively high. These athletes had poor knowledge on peri-workout dietary supplementation. The outcomes of this research highlighted the importance of developing and restructuring strategies in nutrition counselling and education programs targeting athletes to improve their overall performance.

***Keywords**: Behaviours, beliefs, perceptions, peri-workout, supplements*

[1] Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.
[2]Institute of Sport Medicine, No 33, Torrington Place, Colombo 7, Sri Lanka.

Body composition and energy balance of high-performance athletes in the national athletic pool in Sri Lanka

H.P.T.D. Wickramarathna[1], H.A.M.U. Weerasooriya[1], U.N.J. Dahanayake[2], D. Senanayake[2], K.D.R.R. Silva[1], and A. Chandrasekara[1]

Proper, well-balanced nutrition is essential for supporting an athlete's general health and training needs. However, data on the dietary intake and body composition of national-level athletes in Sri Lanka is limited. Hence, this case series study aimed to assess the body composition and dietary intake of high-performance athletes (those who have been identified as having the potential to win international medals) in the national athletic pool in Sri Lanka. Twenty-nine (n = 29) athletes (male = 17; female = 12) from the Sri Lankan national athletic pool were assessed for body composition (using bioelectrical impedance and skinfold thickness measurements), dietary intake of food and nutrients (a 24-hour dietary recall), and physical activity (a 24-hour physical activity recall) in three sports categories (athletic power/speed, athletic endurance, and para-athletic power/speed). According to BMI (Asian cut-off points), 55% were in the normal range, 31% were overweight or obese, and 14% were underweight. Body composition analysis of the athletes showed that the majority (17/27) had a normal fat level, whereas nine (9) athletes had low levels (sprints, field, triathlon) and one (1) had high levels (field). Most of the athletes had "normal" or "high" levels of % muscle mass (26/27), whereas one (1) had a "low" level (field) of a % muscle mass. Nutrient intake results showed that the majority of the athletes consumed an adequate amount of carbohydrates (19/29), and protein (17/29), whereas all the athletes received an adequate amount of fat. However, 59% of the athletes had a negative energy balance. In conclusion, the majority of high-performance athletes in the national pool had appropriate body composition and BMI matched with their respective sports. During the study period, the overall distribution of macronutrients in the diet of athletes was satisfactory although the majority had a negative energy balance considering their usual dietary intake and energy expenditure. Since a certain number of athletes in the national athletic pool in Sri Lanka showed some issues with their diet and body composition, regular dietary counseling and personalized diet plans are suggested to meet their optimal nutrition to enhance their sports performance.

Keywords: *Body composition, Dietary intake, Energy balance, National-pool athletes, Sri Lanka*

[1]Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.
[2]National Institute of Sports Medicines, No. 33, Maitland Place, Colombo 07, Sri Lanka.

Nutritional composition of *Decapterus macarellus:* a common edible fish from Sri Lanka

N.D. Wimalagunarathna[1], B.G.D.N.K. De Silva[1,2], I. Wijesekara[3] and K.V.K. Gunathilake[1*]

Sri Lanka is at the edge of an imminent malnutrition crisis as a result of Covid -19 pandemic and recent economic crisis. Obtaining nutritional foods for economical prices, thus has become a major challenge to overcome protein malnutrition. The present study is aimed to determine the nutritional composition of *Decapterus macarellus* (mackerel scad), a commonly available, low commercially valued fish in the local market. *D.macarellus* samples (N=10) were collected from local fish markets in the Western province, Sri Lanka and morphological measurements were recorded. The histamine level was tested by Enzyme-Linked Immunosorbent Assay (ELISA) and the major nutrients: proteins, fat, carbohydrates, fiber, energy value along with moisture and ash content were analysed in wet weight basis according to methods by Pearson's chemical analysis of foods while minerals: calcium, magnesium, potassium, sodium, zinc, selenium, copper, iron, and manganese were analysed by Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). The morphological measurements were reported with an average standard length of 27.9±1.79 cm and total length of 33.52±1.48cm. Results showed that *D. macarellus* contained histamine 5.25±0.070 mg/kg which is safe in accordance with the European Union food safety criteria. Proximate analysis resulted 3.2% ash, 70.7% moisture, 21.2% protein and 4.9% of fat with a calculated energy of 129 kcal/100g. Carbohydrates were not detected under the detection limit of 1%. Fish samples contained Ca (41.8 mg/kg), Mg (43.5 mg/kg), K (556 mg/kg), Na (135 mg/kg), Zn (2.3 mg/kg) and Se (0.29mg/kg) while Cu, Fe and Mn were not detected. Thus, *D. macarellus* is a preferable nutritional source available for comparably low cost in the Sri Lankan market. Further comprehensive analysis on amino acid profile, vitamins and fatty acid profile are underway to generate a full nutritional profile of *Decapterus macarellus.*

Keywords: *Decapterus macarellus, histamine, mineral composition, nutritional profile, proximate analysis.*

[1]Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

[2]Center for Biotechnology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

[3]Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

Level of Physical Activity among 11 – 13 Year School Children in the City of Colombo, Sri Lanka

A.D.D.C. Athauda[1], D.G.N.G. Wijesinghe[2] and G.A.P. Chandrasekara[3]

The worldwide epidemic of overnutrition among children is rising steeply. In Sri Lankan context, according to annual school medical inspection, the highest prevalence of overnutrition was reported among 11 – 13 year school children in the city of Colombo with an upward trend during the past decade. It is well documented that, sedentary life style leads to child overnutrition. Therefore, current study was carried out to investigate the level of physical activity of 11 –13 year school children in the city of Colombo. A cross sectional study was conducted using 634 subjects studying in 12 randomly selected national and provincial schools in the city of Colombo. The subjects were recruited using multistage stratified cluster sampling technique. The level of physical activity of subjects was determined using Physical Activity Questionnaire for Older Children (PAQ –C) and height, weight and waist circumference were measured. Overweight and obese children were identified using age and sex specific WHO growth charts developed for children aged 5-19 years in Sri Lanka. Abdominal obesity was determined using waist: height ratio. Mean physical activity scores were calculated and compared using the analysis of variance (ANOVA). Mean BMI of boys and girls were 18.44±4.29 kgm^{-2} and 18.21±4.13 kgm^{-2} respectively. The prevalence of overweight and obesity among boys were 15.70% and 14.05% respectively, in contrast 20.45% of girls were overweight and 6.25% of girls were obese. Further, prevalence of abdominal obesity among boys was 44.33% and girls was 35.75%. Mean physical activity score was 2.49±0.63, indicating subjects were low in physical activity. Boys were more physically active (mean physical activity score = 2.68±0.59) than girls (mean physical activity score = 2.26±0.61) ($p< 0.001$). Further, level of physical activity among national school children (mean physical activity score = 2.62±0.64) was higher than that of the provincial school children (mean physical activity score = 2.38±0.61) ($p<0.001$). Hence, school children aged 11-13 years in the city of Colombo are low in physically activity and boys were more physically active than girls as well as national school children were more physically active than provincial school children.

Keywords: *Overnutrition, physical activity level, school children*

[1]Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.
[2]Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka.
[3]Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Sri Lanka.

Physicochemical And Textural Properties of Cottage Cheese Enriched with Jackfruit Seed (*Artocarpus heterophyllus*) Powder

K.G.T.S.D. Bandara[1], K.M.G.M.M. Kariyawasam[1]

The present study was aimed to study the feasibility of using jackfruit seed powder as a protein enrichment in cottage cheese and evaluate physicochemical and textural properties of the product. Two samples of cottage cheese were prepared by using milk, commercial starter culture, rennet and jackfruit seed powder (CJ) and the control sample without powder. A sensory evaluation was conducted to determine the suitable level of jackfruit seed powder (1.5, 2, 2.5 & 3%) for cottage cheese preparation by using 30 semi-trained panellists. The samples were stored in refrigerator (4°C) for further analysis of proximate composition, physicochemical properties, antioxidant activity, textural properties and microbial properties. Based on the sensory evaluation, cottage cheese with 1.5% jackfruit seed powder (CJ) was chosen as the best treatment. Results revealed that CJ had a higher protein content (25.73±0.05%) compared to CC (22.733±0.11%) and it might be due to high protein content in jackfruit seed powder (16.013±0.005%). There was no significant difference in the antioxidant activity (0.42%) and other proximate compositions (1.41±0.09% ash and 18.33±0.57% crude fat), compared to control sample. Results also showed that addition of jackfruit seed powder into cottage cheese did not affect the textural properties. Total plate counts were within the permitted levels while yeast & mold counts were absent in all samples up to 3 days of storage. The pH value showed a significant difference ($p<0.05$) among CC (4.52±0.06) and CJ (4.42±0.10), but TA did not show any significant difference ($p>0.05$) among CC (1.98±0.33%) and CJ (1.81±0.28%). Changes in organoleptic properties of the cottage cheese was found beyond 14 weeks. This study has demonstrated that the protein content of cottage cheese can be increased by adding jackfruit seed powder without affecting sensory or other textural properties, implying that it has the potential to be used as a protein supplement in the dairy industry.

Keywords: *Cottage cheese, Jackfruit seed powder, Protein enrichment, Textural properties*

[1] Department of Biosystems Technology, Uva Wellassa University of Sri Lanka, Sri Lanka.

Effect of a school-based physical activity intervention on health-related physical fitness in 11–13-year-old Sri Lankan children

H.P.M. Dabare[1#], V.P. Wickramasinghe[2], P.H.I.U. Waidyatilaka[3], R. Wickremasinghe[4], A.P. Hills[5]and P. Lanerolle[3]

Health-related physical fitness (HRPF) parameters are more often associated with disease prevention and health promotion than skill-related parameters. Currently, there are no data related to the effect of physical activity interventions on HRPF in Sri Lankan children. This study aimed to explore the effect of a physical activity intervention on the HRPF parameters. A cluster randomized controlled trial was conducted in 389 children aged 11-13 years (mean age 12.0 ± 0.83 years; 50.6% girls) from 12 schools in Colombo. Schools were randomly assigned to intervention (n=6) and control groups (n=6). The intervention group consisted of 197 children and 192 in the control group. The physical activity intervention was designed using comprehensive situational analysis. The intervention group followed a 30-minute programme on three days/week, for 3 consecutive months. The control group followed their normal routine activities. At baseline and follow-up, HRPF was assessed using a number of field tests. A comparison of baseline and post-intervention data, saw muscular strength and endurance, measured by the curl up (intervention group: 3.36 ± 3.35 vs control group: 0.11 ± 2.57) and push-up test (intervention group: 1.08 ± 3.94 vs control group: 0.28 ± 1.67), significantly ($P < 0.05$) higher in the intervention group. Muscular flexibility measured using the sit and reach test (intervention group: 5.23 ± 2.22 cm vs control group: 0.28 ± 4.39 cm) was also significantly ($P < 0.05$) increased in the intervention group following the intervention. An evidence-based intervention programme was developed, which increased muscular fitness and flexibility among children with potential for implementation through the national education system. Financial assistance was provided by International Atomic Energy Agency, Vienna (Technical Cooperation project SRL/06/035).

Keywords: *Children, Health-related physical fitness, Physical activity Intervention, School-based.*

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[#1]Department of Physiotherapy, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Sri Lanka
[2]Department of Pediatrics, Faculty of Medicine, University of Colombo, Sri Lanka
[3]Department of Biochemistry and Molecular Biology, Faculty of Medicine, University of Colombo, Sri Lanka
[4]Department of Public Health, Faculty of Medicine, University of Kelaniya, Sri Lanka
[5]School of Health Sciences, College of Health and Medicine, University of Tasmania, Australia

Use of a photographic method to assess dietary intake of elders; A pilot study

Gayan Sampath Premadasa [1], Roshan Delabandara[2], Anoma Chandrasekara [1,2]

Dietary assessment of elders is comparatively challenging to succeed using retrospective reporting methods. This study aimed to establish and validate a food photographic method to determine food and nutrient intake of elders. Twenty community-dwelling elders (10 male and 10 females) participated in the study. All dietary information was collected as observational data at the natural dwelling of participants. With prior notice food intake of subjects was observed. Three photographs of each meal were taken. Validation of the food intake recorded by photographs was made by comparing it with the three-day diet diary recorded in household measurements. Digital photographs were taken using a smart mobile phone of all main meals for 3 days and a three-day diet diary (DD), and a food frequency questionnaire (FFQ) was completed by an interviewer. At the laboratory, all food items were prepared and quantities of household measurements were photographed and used as standard food photographs (SFP). An estimate of the amount of food consumed recorded by photographs during the meal occasions was made using SFPs by a dietician. Food and nutrient intake recorded by the photographic method was validated using information recorded by DD. The comparison was made using 7 nutrients. Protein, potassium, and fat were underestimated by 2.7, 5.9, and 7.6 %, respectively. Energy, carbohydrate, fiber, and calcium were overestimated by 1.8, 5.9, 1.8, and 5.2%, respectively. Bland Altman's analysis showed that differences between both methods were random and did not exhibit any systematic bias over levels of nutrient intake, with acceptable 95% limits of agreement. The photographic food records method can be used to estimate dietary intake accurately in the elderly population. Further research is warranted to improve this method as this is less burden and is practical to be used by the elderly and their family members to determine food intake.

***Keywords**: Dietary assessment, Digital food photograph, Elders, Three-day diet diary,*

[1] Wayamba University of Sri Lanka, Sri Lanka,
[2] Nutrition Society of Sri Lanka, Sri Lanka

Dietary Exposure to Artificial Food Additives in a selected Grama Niladhari Division, Kalutara, Sri Lanka

M.A. Dhananjani[1], W.T.R. Wickramasinghe[1], K.P.D.C Pathirage[1], E.A.M. Ransika[1], B.A.S. Yuwanthika[1], H.Kulathunga[1], D.L.N.L. Ubhayawardana[2]

Artificial food additives have different functions, such as enhancing the flavor, improving texture, enhancing the color, and preserving the foods. Several chemical reactions are used to develop synthetic additives, which could potentially be a risk to the health. Certain chronic disorders, such as cancers, diabetes, and food allergies will be the ultimate result of the prolonged usage of artificial food additives. Determination of dietary exposure to artificial additives can help make wiser choices in consumption following low health risks. The study was designed and conducted to determine the exposure to artificial food additives in the selected community in Sri Lanka. This study is a descriptive cross-sectional study. A systematic random sampling method was used and the survey was carried out on 250 respondents in Kotigamgoda Grama Niladhari Division. The pre-tested self-administered questionnaire that consists of socio-demographic data and dietary practices about artificial food additives was used. Dietary exposure was graded high, low, and moderate using Bloom's cut-off points. The mean score of dietary exposure to artificial food additives was 9.63±2.49. The majority of the participants 114 (4.6%) had low exposure while 78 (31.2%) had moderate exposure and 58 (23.3%) had high exposure. Most of the participants indicated that they usually checked for the ingredients of foods, such as soft drinks, snacks, and instant foods. People who suffered from certain non-communicable diseases mentioned that they expected quality and nutrients more than the taste and appearance of foods. Results of the study suggest that less exposure to artificial additives is a vital step for initiating a healthy generation. Improving public awareness of this kind of dietary practice will help to reduce non-communicable diseases in the future. Further studies are necessary to confirm exposure to artificial additives in various communities.

***Keywords**: Artificial Additives, Dietary Exposure*

1 Department of Biomedical Science, Faculty of Health Sciences, KIU
2 Department of Basic science & Social Science, Faculty of Nursing, University of Colombo

Trends in undernourishment and food insecurity in Sri Lanka from 2001 to 2020: a joinpoint regression analysis

S.M. Al Hasan[1], J. Saulam[2,3], F. Mikami[2], and H. Yokoi[2]

Historically, Sri Lanka has placed a high value on basic human needs, resulting in the country achieving substantial developments in human welfare. However, about one-quarter of the population remains below the official income poverty line which might affect the undernourishment and food insecurity in this country. We aimed to quantify and track the changes in the prevalence of undernourishment and food insecurity (moderate or severe) in Sri Lanka from 2001 to 2020. We used the prevalence of moderate or severe food insecurity and prevalence of undernourishment in the population data compiled in the Food and Agriculture Organization Corporate Statistical Database for our trend analysis. The joinpoint regression model was applied to analyze the temporal trends. We reported a relative metric, the annual percent change, of the trends. In 2020, one in every two adult males and two in every five adult females in Sri Lanka were moderate to severely food insecure. The moderate or severe food insecurity among the adult population increased significantly since 2017. The annual growth rate in moderate or severe food insecurity prevalence among adult males and females was 16.24%. The prevalence of severe food insecurity increased markedly by 22.1% per year in females and 21.7% per year in males between 2017 and 2020. However, undernourishment prevalence showed a decreasing trend in Sri Lanka. The prevalence of undernourishment decreased significantly by 8.0% per year from 2001 to 2020. The velocity of the declining trend was faster between 2012 to 2015 (by 14.0% per year), which slowed down to 8.3% per year between 2015 to 2020. The prevalence of undernourishment constantly decreased in Sri Lanka since 2001, however, moderate or severe food insecurity among the adult populations increased significantly since 2017. These findings hypothesize that since 2017, people with insufficient habitual food consumption might become more food insecure in Sri Lanka.

Keywords: *Food insecurity, Joinpoint regression analysis, Sri Lanka, Undernourishment.*

[1]Clinical Research Support Center, Kagawa University Hospital, Kagawa, Japan.
[2]Department of Medical Informatics, Faculty of Medicine, Kagawa University, Kagawa, Japan.
[3]Department of Food Processing and Nutrition, Karnataka State Akkamahadevi Women's University, Vijayapura, Karnataka, India.

Development of purple yam (*Dioscorea alata*) powder incorporated ice cream, and determination of physicochemical properties

K.N. Jayarathna[1], S.M.A.C.U. Senarathne[2], K.M.G.M.M. Kariyawasam[1], J.K.H. Sampath[1]

Locally available varieties of tuber crops are not fully utilized as a food ingredient by the food industry. Purple yam (*Dioscorea alata*), is a tuber species that possesses the high potential to use as a food ingredient rich in antioxidants, vitamins, minerals, proteins, fat, and carbohydrates. The objective of this study was to develop purple yam and soy milk incorporated vegan-friendly, non-dairy ice cream with improved sensory attributes and functional properties. The ice cream samples were produced using three formulations with purple yam powder (1.2%, 3.2%, 5.2%). The control sample was produced using soya milk. The developed ice cream samples were stored at (-18 °C) for further analysis. Proximate composition, functional activities, physicochemical, microbiological, and organoleptic properties were determined. The ice cream sample with 3.2% purple yam powder was scored the highest sensory mean scores (4.70±0.52), higher antioxidant activity (75.23±0.03%), phenolic activity (3.97 mg/g), total solids (32.43±0.15%), milk solid non-fat (14.70±0.05%), meltdown rate (0.14 ± 0.004 g/min) compared to the control sample. The addition of purple yam powder has increased protein (1.4%), fat (10.51%), and dietary fiber (2.12%). There was a significant difference in pH (6.05±0.01) and titratable acidity (0.12±0.00%) compared to the control sample ($p<0.05$). Microbiological tests confirmed three months shelf-life period under the frozen condition without adding the preservatives. In conclusion, the formulation of ice cream with purple yam powder has been successfully improved the sensory, nutritional, and functional properties of the developed ice cream.

Keywords *– Antioxidant activity, Functional food, Non-dairy ice cream, Purple yam*

[1] Department of Biosystems Technology, Faculty of Technological studies, Uva Wellassa University of Sri Lanka
[2] Food Research Unit, Department of Agriculture, Gannoruwa, Peradeniya, Sri Lanka

Awareness on Nutrition, Sports supplements and Doping substances among the Under 17 Male National Youth Cricket Squad in Sri Lanka

B.I.L.M. Mendis[1*], W.D.W. Senanayake[2], A.M.D.K. Attanayake[2], and C.M. Wickramathilake[3]

Nutrition is a vital component of training, performance and the development of young cricketers. The aim of this study was to assess current knowledge on nutrition and the prevalence of supplement usage among the National Youth Cricket Squad (NYCS) cricketers. All members of the male under-17 Sri Lankan NYCS (n=60) were recruited for the study. Interviewer-administered questionnaire was used to collect the data. The mean age (SD) of the sample was 16(±0.7) years. Their mean (SD) duration of cricketing experience, training days per week and hours for a particular training session were 6.6 (±2) years, 2.2(±0.6) days and 2.6 (±0.9) hours respectively. There were 28% batsmen, 12% fast bowlers, 7% spinners, 36% batting all-rounders and 17% bowling all-rounders. Among them 15% were underweight while 3% were obese. Out of all the NYCS cricketers, only 28% recognized carbohydrate as the main energy source whereas 78% knew that protein is necessary for muscle development. Majority of the subjects were not aware about the main recovery macronutrient as carbohydrate. According to 80% of them, the best fluid for training was water, for 17% it was energy drinks and for 2% it was sports drinks. The prevalence of supplement usage was recorded as 15% (sports drinks 5%, vitamins 5%, whey protein 3% and others 2 %). Most of the cricketers were aware of the existence of doping rules (90%), but their level of awareness was poor (83% just heard). Although none of the subjects knew about types of doping substances, 62% believed that supplements might contain doping substances. The main sources of nutrition knowledge were the coaches (98.33%) and the YouTube (86.66%). It was revealed that there is a gap in the basic nutrition knowledge, and awareness of the anti-doping substances. Thus, basic education, awareness programs on nutrition and anti-doping for school cricketers are of immense importance to improve their knowledge and performances.

Keywords: *Attitudes, BMI, Cricketers, Knowledge, Nutritional supplements*

[1]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya (20400), Sri Lanka.
[2]Institute of Sports Medicine, Maitland place, Colombo 7 (00700), Sri Lanka.
[3]Department of Biochemistry, Faculty of Medicine ,University of Ruhuna ,Galle (80000) ,Sri Lanka.

Development of Butternut Squash (*Cucurbita moschata)* Spicy Sauce and Evaluation of its Physicochemical, Nutritional, and Sensory Properties

H.L.G.M Nilmini[1] and W.M.W.W Kandegama[2]

Butternut is a seasonal product in Sri Lanka, showing rapid fluctuations in price and quality. It's a perishable crop because its high moisture content. Production of sauce is a preservation method. The development of sauce was carried out to optimize consumer acceptance. A preliminary trial was conducted by preparing four recipes including chili powder, black pepper, green chili and *kochchi* with two commercial sauce samples. The optimum level of butternut: tomato pulp ratio, acceptable chili & coriander ratio as evaluated through sensory tests. Coriander (0.1 g) , 5 g of chili / 50:50 ratio of butternut & tomato obtained the highest mean score (T1). T1 was evaluated for physicochemical, nutritional, functional, antimicrobial & storage stability without artificial preservatives. The pH 4.63, Total soluble solid (TSS) 29.81°, Titratable acidity (TA) 0.81 % was in the acceptable range according to SLSI standards. The proximate composition, moisture 82.7 %, ash 0.9 %, protein 1.2 %, fat 0.7 % carbohydrate 14.5 %, and energy 69 kcal/100 g. T1- coriander/butternut sauce shows the results of total antioxidant capacity (TAC) 5.58±2.25 (mg TE/g DW), total phenolic content (TPC) 0.98±0.12 (mg GAE/ g DW) and total flavonoid content (TFC) 1.19±0.12 (mg RE/g DW) respectively. Antimicrobial efficacy of (T1 & T4 without coriander/butternut sauce) checked by disc diffusion method (DDM), T1 & T4 shows bacterial Inhibition zones of 21.1 and 15.6 mm respectively. According to the results, E.coli is susceptible against (T1) and E.coli intermediate susceptible against (T4). Previous studies have demonstrated that essential oils in coriander have antibacterial effects against germs that are food-borne. The new product showed no significant difference ($p>0.05$) in (TA), pH, and (TSS) within 30 days of refrigerated (4 °C) storage. The shelf life of the sauce could be further enhanced by adding recommended food preservatives within limits.

Keywords: *Butternut Squash, Post-harvest losses, Sauce, Sensory attributes, Spices.*

[1]Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.
[2]World Health Organization, Regional Office for South East Asia, New Delhi, India.

The Awareness on and Usage of Growth Charts and Feeding Information of the Child Health and Development Record by the Mothers in Bope-Poddala Medical Officer of Health Area: A Cross-Sectional Study

C.E.Paranavithana[1], K.K.W.J.C. De Siva[2]

Better awareness and usage of growth charts and feeding information of the Child Health and Development Record (CHDR) would enable mothers to be aware on the nutritional status of their children and would encourage mothers to play an active role in promoting and protecting the health and nutritional status of children. The objective of the study was to find out the awareness and usage of growth charts and feeding information of the CHDR by the mothers in Bope-Poddala MOH area. A cross-sectional study was conducted among systematically selected by 422 mothers of children below five-years attending Child Welfare Clinics of Bope-Poddala MOH area. Data were collected using a pretested interviewer-administered questionnaire and were analyzed using SPSS version 25.0. Descriptive statistics, a scoring system, chi-square and t-tests were used. $p<0.05$ was considered as the level of significance. The majority of the mothers were Sinhalese (n=412, 97.6%) and 180(42.3%) were educated up-to grade 13. Almost all (n=421, 99.8%) mothers were aware about the sections on growth and about 98% of mothers were aware about information on complementary and breastfeeding. The awareness and usage of growth charts among mothers were inadequate with only 163(38.6%) and 200(47.4%) showing satisfactory levels respectively. Only 27(6.4%) were aware about the BMI charts. However, awareness and usage of feeding information were satisfactory with 358(84.8%) and 349(82.7%) mothers showing satisfactory levels respectively. Awareness on growth charts was associated with educational level and employment status of mothers, monthly income and nature of the family ($p<0.05$). The usage of growth charts was associated with educational level of mothers, monthly income and age of the child ($p<0.05$). The awareness and usage of growth charts by mothers of children below five-years residing in Bope-Poddala MOH area were inadequate while awareness and usage of feeding information were satisfactory. Therefore, the available programmes to make the mothers aware on growth charts and interpretation should
be further strengthened.

Keyword: *Awareness, Child Health and Development Record, Growth charts, Mothers of children below 5 years*

[1]Department of Nursing, Faculty of Allied Health Sciences, University of Ruhuna
[2]Department of Community Medicine, Faculty of Medicine, University of Ruhuna

Development of a website on vitamin D nutrition to educate the young adults in Sri Lanka

T.P. Pathirage[1] and R.M.T.K. Ranathunga[1]

Poor nutrition education is one of the modifiable risk factors for inadequate nutritional status in many population groups in Sri Lanka. The digital platform is a potential novel method to educate young adults on nutrition. Little emphasis has been given to educating the general public on vitamin D nutrition in Sri Lanka using novel technology. Therefore, the aims of the present study were to identify the knowledge gaps of vitamin D nutrition among young adults and to develop a website to educate them on vitamin D. Eighty young adults (18 – 44 years) were recruited for the study through social media by publishing a post about the study to identify the knowledge gaps in the vitamin D. Online questionnaire was used to gather the knowledge on vitamin D. A website called "NutrivitD" was developed addressing the identified knowledge gaps. The web link was sent to professionals in the nutrition field to get their feedback on the content and the appearance of the website. About 50% of young adults were unaware of the functions of vitamin D, while 41% of young adults were unaware of the main sources of vitamin D. About 88% of study participants were not knowledgeable on daily vitamin D requirements. The website consisted of basic information on vitamin D, such as metabolism of vitamin D, sources and functions of vitamin D, assessment of vitamin D status, Recommended Daily Allowances for Vitamin D, Vitamin D Deficiency (VDD), prevention of VDD and Frequently Asked Questions (FAQs) on vitamin D nutrition. The website was improved after getting feedback from professionals. The efficacy of the website in educating young adults on vitamin D will be determined in future studies. This website might be able to use as a tool to educate young adults and health professionals on vitamin D nutrition.

Keywords: *Nutrition education, Vitamin D, Website, Young adults*

[1] Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.

The key determinants of vascular function among Sri Lankan healthy adults

U.L.D.S Perera[1], G.N.M Gunathilaka[1], M.A.R.M.P Jayathilake[1], A. Chandrasekara[1] and K.M. Rathnayake[1]

Cardiovascular diseases (CVDs) are the leading cause of death and emerging health burdens globally as well as in Sri Lanka. Vascular function and its components including blood pressure, arterial stiffness and endothelial dependent vasodilation have emerged as critical early modifiable risk factors in the development and progression of CVD. There were very limited studies which assessed arterial stiffness (AS) and associated determinants among Sri Lankans. This study aimed to determine the levels of vascular function components among adults and associated key determinants. In a cross sectional study n=401 healthy adults aged between 30-60 yrs (Mean±SD, 42.5±8.3) including 243 males and 158 females free from previously medically diagnosed chronic diseases were recruited. AS was measured in terms of pulse wave velocity (PWVc-f) using an oscillometric Mobil-O-Graph® PWA Monitor device. A 3-day diet diary including two week days and one weekend day was used to assess the usual nutrient intake. Body composition was assessed using a multi-frequency segmental body composition analyzer. A fully automated biochemistry analyzer was used to analyze fasting serum samples. Stepwise multiple linear regression analysis model was used to identify the most associated predictors. Means (SD or interquartile range) of PWV, systolic blood pressure (SBP), diastolic blood pressure (DBP), Augmentation index@75(AI@75) and pulse pressure were 6.5(±1.1) m/s, 122.0 (113.0-132.0) mmHg, 80.4 (±10.9) mmHg, 24.7 % (±11.0), 43.6 mmHg (±10.3), respectively. While age was the key independent predictor of PWV determining 72% of its variation, visceral fat level was the major determinant of SBP (r^2=0.116). Gender was the key contributor of DBP (r^2=0.123) and AI@75 (r^2 =0.182). In conclusion, whereas age and male gender were the key positive correlated non-modifiable predictors while visceral adiposity was the key modifiable determinant of vascular function among Sri Lankan adults.

Keywords: *Age, Arterial stiffness, Gender, PWV, Vascular function, Visceral adiposity*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura (60170), Sri Lanka

Associated factors of body fat and visceral adiposity in healthy adults

U.L.D.S Perera[1], M.M.S.K Karunanayake[1], A. Chandrasekara[1] and K. M. Rathnayake[1]

South Asians including Sri Lankans display a unique body composition phenotype leading to high cardiovascular disease risk (CVD). Fat accumulation in the abdominal area especially visceral adipose tissue is associated with greater CVD risk compared with gynoid adiposity. This study aimed to elucidate body fat composition and associated factors in healthy adults. In a cross sectional study 401 healthy adults aged between 30-60 years were recruited using purposive sampling method from Wayamba university premises and its surrounding areas. A-3 day diet diary including two week days and one weekend day was used to assess the usual nutrient intake. Body composition was assessed using a multi-frequency segmental body composition analyzer. A fully automated biochemistry analyzer was used to analyze fasting serum samples. All associated independent predictors of body fat composition identified via spearman regression were entered in to stepwise multiple linear regression analysis model and the most associated predictors were recognized. Mean age of the study participants was 42.5 years (SD,±8.3). Gender was the most crucial independent predictor contributing 53% of variability in percentage of total body fat (TBF%) while 27.5% in visceral fat level. Visceral adiposity was higher in males; (10.6±3.5, P<0.001) whilst TBF% level was higher in females (35.4±6.1, P<0.001). Age was found to be independently determined 2% variability only in visceral fat level. Percentage of total dietary fat (TF%) and carbohydrate (CHO%) intakes were also independent predictors depicting 1.6% variability in TBF level and 1.4% in visceral fat level, respectively. With increase of TF% intake from quartile 1 (Q1) to quartile 4 (Q4), visceral fat level in Q4 significantly higher compared to Q1, Q2 and Q3 levels (P=0.002). Serum triacylglycerol (r=0.327, P=0.002) and glucose (r=0.311, P=<0.001) showed significant independent positive correlations while HDL-cholesterol (r=0.352, P=0.007) showed a significant independent negative correlation with visceral fat. In conclusion, while gender and age were the prudent non-modifiable predictors, TF% and CHO% were the prudent modifiable determinants of body fat level and visceral adiposity among the study population

Keywords: *Age, Body fat, Gender, Visceral adiposity.*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura (60170), Sri Lanka

Development and Nutritional Analysis of Purple Yam (*Dioscorea alata* L.) Flour Based Healthy Pudding Mix

A. G. S. K. Pushpakumara [1] , L. A. Wickramaarachchi [1], and H.M.T. Herath [*1]

Purple yam (*Dioscorea alata* L.) is an undiscovered, potential source of food ingredient in Sri Lanka containing an array of nutrients. The present study aims to process purple yam into shelf-stable flour and develop a ready-to-cook pudding mix in order to increase reliable access and the product diversity. Slices of *D. alata* yams were blanched at 80°C for 5s, dried at 60°C for 24h, powdered, and sifted through a 300 µm sieve to process the yam flour. The net yield of the flour was 26.8±0.75%. The pudding mix was developed with appropriate portions of purple yam flour, ground sugar, and carageenan. Pudding preparation requires the addition of water and full-cream milk powder to the pudding mix. The amounts of ingredients in the pudding mix and the preparation conditions were optimized through several trials in order to achieve the best sensory properties in the final product. The physical, chemical, and sensory properties were measured and analyzed statistically using SPSS software. The sensory properties in terms of appearance, colour, manual thickness, melting, creaminess, mouth feel, flavour, sweetness, and overall acceptability were analysed by a trained panel of 15, and each property scored above the 6.5 average value. The moisture content, water activity, and colour of the pudding mix were 3.98±0.30%, 0.40±0.01 and L-36.10±1.0 a-3.28±0.1 b-0.16±0.0 respectively. The nutritional profile in the pudding mix and the prepared pudding were analyzed separately and resulted 1.70±0.2%, 0.63±0.04% of ash; 4.27±0.09%, 2.55±0.15% of crude protein; 0.42±0.08%, 0.25±0.12% of crude fat; 0.88±0.03%, 0.36±0.04% of crude fibre; 88.75 ±0.35%, 23.58±0.95% of carbohydrates and 375.83±0.69 kJ, 106.76±4.54 kJ of energy (wb) with potassium (0.6±0.1, 0.23±0.01) and calcium (0.07±0.04%, 0.08±0.00%) as the major minerals in respectively. In conclusion, *D.alata* yam flour is a suitable ingredient for the development of nutritious food products and provides a natural purple colour.

Keywords: *Dioscorea alata L., Pudding Mix, Purple Yam Flour*

[1]Food Technology Section, Industrial Technology Institute, 503/A, Halbarawa Gardens, Malabe, Sri Lanka.

Energy balance and hydration status of Sri Lankan Air Force athletes

K.N.D. Ranasinghe[1], R.M.T.K. Ranathunga[1], T.S.M. Thilakarathna[2], G.A.P. Chandrasekara[1]

Optimum nutrition is essential for athletes for better sport performance. Sufficient energy intake and optimum hydration status are key factors that are associated with sport performances. The aims of the present study were to identify the energy balance and hydration status of Sri Lankan Air Force athletes. Thirty six sportsmen and 48 sportswomen aged 20 to 40 years from Sri Lankan Air Force were recruited. Three-day diet diaries and physical activities diaries were used to determine the daily dietary intake and energy expenditure, respectively. The interviewer administrated questionnaire was used to gather the socioeconomic information. Urine samples were collected to determine the specific gravity using a Urinometer to determine the hydration status. Athletes were categorized into four groups (well hydrated, minimally dehydrated, significantly dehydrated, seriously dehydrated) based on the specific gravity values. Diet diaries were analyzed using a computer software (FoodBase 2000) to determine the daily energy intake while physical activity diaries were used to calculate the daily energy expenditure. The mean energy intakes of male and female athletes were 44.5 kcal/kg/day (SD=13.9) and 37.4 kcal/kg/day (SD=12.9) respectively. The mean energy balance was -272.9 (SD 756.8) kcal/day. Energy balance of male and female athletes was -186.0 (SD 805.4) and -338.1 (SD 719.9) kcal/day, respectively. Of total sample, about 63.1% of athletes were on negative energy balance. The majority of athletes (69%) were belong to "Minimally dehydrated" category while 28.6% of athletes were belong to "Well hydrated" category. Similar percentage of athletes (1.2%) were reported for both significantly dehydrated and seriously dehydrated categories. Sports types (p=0.003) and age (p=0.025) were significantly associated with energy balance. In conclusion, the majority of Air Force athletes do not fulfil the required energy intake and fluid intake. Nutrition education programs should be conducted emphasizing the need for a balanced diet and adequate fluids for Air Force athletes.

***Keywords**: Athletes, Energy balance, Hydration status*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila, 60170 NWP, Sri Lanka
[2] Sport Medicine Unit, Sri Lanka Air Force, Katunayaka, Sri Lanka

Students' opinion about the school food literacy education in Sri Lanka

M.P.S. Rathnayake[1], J. Nanayakkara[2], T. Perera[1], A. Worsley[3], A.O. Booth[2] and K.D.R.R. Silva[1]

Increasing incidences of diet-related adverse health conditions among people in all age groups have been identified as a result of unhealthy dietary practices and diminishing food skills. School food literacy education has been identified as one of the ideal preventive measures to reduce diet-related diseases as well as undernutrition. There are no studies that have investigated students' opinions on school food literacy education. This qualitative study was designed to capture the insights of secondary school students about the current food literacy education in Sri Lankan schools. Six focus group discussions were conducted with grade 9 students (n=40) in three Provinces (Southern, North Western, and Central) in Sri Lanka. Students' interests, opinions, attitudes and some behaviours related to the current food literacy education were explored using semi-structured open-ended questions. Further, their suggestions to improve food literacy education were examined. All discussions were recorded, transcribed, and translated to English. The themes emerged were; favorite topics or lessons, practical exposure, willingness to learn food and nutrition, their confidence in food and nutrition, barriers, how they practice, what they learn, ability to communicate the nutrition information, applicable strategies to make food literacy education more strong, and school food environment. The students were interested in learning food literacy in schools, and they believed that it is an important aspect in school education. All students said that they engage enthusiastically in practical sessions, especially in cooking. However, students had fewer tendencies to practice learned skills at home. Students were not highly confident in their food and nutrition knowledge or in their ability to communicate nutrition information with others. Lack of qualified and trained teachers and inadequate kitchen facilities were mentioned as the main barriers. Inclusion of more practical sessions and conducting teacher training would improve food literacy education in Sri Lanka.

Keywords: *Focus group discussions, Food literacy education, School, Students, Qualitative research*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka.
[2]Deakin University, Geelong, Australia, Institute for Physical Activity and Nutrition (IPAN), School of Exercise and Nutrition Sciences
[3]School of Exercise and Nutrition Sciences, Deakin University, Geelong, VIC, 3220, Australia.

Socio-economic predictors of body mass index- for-age of adolescent girls in Karnataka: a cross-sectional study

J. Saulam[1,2], S.M. Al Hasan[3], R. Kanakikoppa[2], F. Mikami[1], and H. Yokoi[1]

Reports of the National Health and Family Survey have highlighted that the rate of malnutrition among adolescent girls is alarmingly high in India, yet it goes largely unrecognized in children as well as in adolescents. This study aimed to assess the socio-economic factors associated with nutritional status based on the body mass index- for-age (BMI-for-age) Z scores of adolescent schoolgirls in the Vijayapura district of Karnataka. This school-based study was cross-sectional in design where 344 adolescent girls aged 12–19 years were randomly selected from a pre-designed sampling frame. An interviewer-administered questionnaire and anthropometric measurement were done for each of the schoolgirls. The anthropometric measurements of each participant were converted to the indices of nutritional status (Z-score based) using World Health Organization Anthro Plus software. The mean BMI for age Z-score of the adolescent schoolgirls was -0.75. The overall prevalence of short stature among these adolescent girls was as high as 42.5%. The prevalence of thinness was found at 12.8% among adolescent schoolgirls. Applying a multivariate linear regression model, we found that schoolgirls' mothers involved in income-generating activities and the occupation of their fathers significantly predicted the variance in BMI-for-age Z scores of the adolescent schoolgirls. The predicting models calculated about 42.3% variance in BMI-for-age Z scores of the adolescent schoolgirls. BMI-for-age Z scores of the adolescent schoolgirls would be expected to be 0.59 (95% CI: 0.27 to 0.92) points higher for schoolgirls whose mothers were involved in income-generating activities. Moreover, BMI-for-age Z scores were found 0.51 (95% CI: 0.14 to 0.88) points higher for schoolgirls' fathers working as skilled workers compared to farmers and daily workers. About one in every eight adolescent schoolgirls in the Vijayapura district of Karnataka was found malnourished. Parents' income was significantly associated with thinness among these adolescent schoolgirls.

Keywords: *Adolescent schoolgirls, Body mass index-for-age, Parents' income.*

[1]Department of Medical Informatics, Faculty of Medicine, Kagawa University, Kagawa, Japan.
[2]Department of Food Processing and Nutrition, Karnataka State Akkamahadevi Women's University, Vijayapura, Karnataka, India.
[3]Clinical Research Support Center, Kagawa University Hospital, Kagawa, Japan.

Effectiveness of multidisciplinary approach availability at primary care level for weight reduction-Case study

Y.Shanmuganathan[1]*, R.P.Saseenthan[1], V.Sureskumar[1] and S.Kumaran[1]

Weight gain is one of the risk factors for Non-Communicable Diseases (NCDs) which can be managed at primary care level. Multi-disciplinary perception through weight reduction for NCD care is evidently a proven strategy which is not available in Sri Lankan primary care level. The study aimed to assess the effectiveness of multi-disciplinary perception's availability at primary care level for the NCD management through weight reduction. A two-year study period (2020-2022) was agreed with the Family Health Center (FHC), Kondavil. Patients with Body Mass Index (BMI) of $\geq 30 Kgm^{-2}$ were selected from the NCD register and targeted to reduce 10% of their current weight through a planned behavioral changing model with a team that includes Nutritionist, Nursing Officer, Consultant Family Physician and Medical Laboratory Technician. The intervention package included lifestyle pattern analysis, risk factor identification, blood parameter analysis, individual plans for diet, physical activity, relaxation and medical management. Motivational interview, social marketing and nudging were used as behavioral changing techniques. Seven patients who had $BMI \geq 30 Kgm^{-2}$ (~6%) participated in a weight reduction plan from registered patients for NCD clinic follow-up. During the study period, 86% of the target was achieved along with the observations of controlling blood pressure, fasting blood sugar and total cholesterol levels. The study can be concluded that using multi-disciplinary perception at primary care level is an effective strategy to manage NCDs through weight reduction. Also, the primary care level facilitated the success of study through patient-oriented management plan and routine clinic follow ups.

Keywords: *Multi-disciplinary perception, Non-Communicable Diseases, Primary care and Weight reduction*

[1]Family Health Center, Kondavil- Department of Community and Family Medicine, Faculty of Medicine, University of Jaffna

Consumer Perception on Food Consumption and Non-Communicable Diseases

E.K.D.K.C. Siriwardana[1] and A. Chandrasekara[1]

Non-Communicable Diseases (NCDs) accounted for 83% (2019) of all deaths in Sri Lanka, and the mortality rate has been increasing rapidly during the past decade. Individual dietary behavior depends on perceptions people have about food consumption. The present study aimed to identify current consumer understandings of the inter-relationship between food consumption and NCDs. A cross-sectional online survey was conducted to collect data from 160 participants of convenient sample of adults above the age of 20 years. A self-administrated online questionnaire was the instrument used to collect the data. The questionnaire was prepared by modifying the combination of pre-tested and validated questions used in similar previous studies. Approximately 90% of participants believed that the unhealthy dietary patterns contributed to NCD. According to the participants' understanding, 89% of them believed that a high fat diet was a major risk factor for cardiovascular diseases. In comparison, less number of participants, only 46% and 58%, respectively, believed that low-fiber and high-carbohydrate diets were risk factors for cardiovascular disease. Nearly 53% and 51% of total consumers had correct perception regarding daily servings of fruits and vegetables, respectively as WHO guidelines. However, close to 50% of consumers did not have a clear understanding regarding recommendations. Most participants (51%) perceived that all types of margarine and fat spreads were bad for cardiovascular health. The majority of population (80%) perceived those organic foods as a solution to reduce cancer and kidney diseases. Moreover, people perceived a busy lifestyle and a lack of knowledge about healthy eating as extreme barriers to healthy eating. In conclusion, participants in the study sample correctly perceived that unhealthy eating habits cause NCDs and following a healthier diet and lifestyle would be an effective approach to reducing the burden. However, their knowledge on fat types in general, fruit and vegetable recommendations were not at a satisfactory level.

Key words: *Consumer perceptions, Food types, Healthy eating, Non-Communicable Disease*

[1] Department of Applied Nutrition, Wayamba University of Sri Lanka.

Knowledge, perceptions, attitudes and practices on the use of the front-of-pack (FOP) traffic light labeling (TLL) system among Sri Lankan consumers

G.T. Subasinghe[1] and T. Perera[1]

The traffic light label is one of the most commonly used Front-of-Pack (FOP) labels around the world and has been proposed as a public health strategy to reduce the risk of chronic diseases by guiding consumers toward healthier food choices. The present study aimed to assess the consumer knowledge, perceptions, attitudes, and practices regarding the use of the traffic light labeling (TLL) system and how consumers use TLL to make informed decisions to self-evaluate the healthfulness of packaged food they purchase. A cross-sectional online survey was employed to collect data from participants in August 2021 using convenient and snowball sampling techniques. The mean age of participants was 28.55±11.47 years and 72% of participants were female. Around 60% of participants had a satisfactory level of knowledge regarding TLL. Yet, only 32% of participants were consistent in their use of TLL. Both consumer knowledge regarding TLL ($p < 0.05$) and the use of TLL ($p < 0.05$) were positively associated with consumers' nutrition-related knowledge. Age was significantly associated with the use of TLL ($p < 0.05$). The study found no association between gender and the use of TLL. TLL was viewed favorably by consumers and seen as simple, eye-catching and helpful in making informed dietary choices. However, some consumers had little confidence in the TLL due to a perceived lack of transparency (47%) in the labeling process. Even though TLL has been introduced to Sri Lanka for many years and the knowledge regarding TLL in the studied population was satisfactory, the use of TLL was marginal, indicating that having only the knowledge about TLL will not encourage its use in making informed food choices. Hence, education on the application of TLL in the food choice situation and appropriate monitoring and evaluation of the labeling process by an authorized body would promote the use of TLL among consumers.

Keywords: *Cross-sectional survey, Front-of-pack labels, Traffic light labeling system, Sri Lanka*

Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka.

Analysis of risk factors and propose of a statistical model on Nutritional Status of Children (5-10 years) – A study in Divisional Secretariat Division, Ampara, Sri Lanka.

A.I.Thilakarathna[1], P.Dias[2], K.V.K.Gunathilake[1]

The child nutritional status in rural areas of Sri Lanka is poor studied. The socio- economic status and the diet play a major role on child nutritional status. The present study aims to analyze the association of selected socio-economic and diet-related factors with the nutritional status of children (age group 5-10 years) from three selected Grama Niladhari Divisions in the Ampara Divisional Secretariat Division, Sri Lanka. Data were collected by a self-administrated standardized questionnaire filled by the guardians (n= 136), for a period of 6 months. Weights and heights were measured to calculate Body Mass Index and categorize according to the nutritional status. According to the results of chi-square test of association, twelve factors were identified to have a significant association ($p < 0.05$) with the current nutritional status of the study population; status of birth weight, status of weight gain up to age five , monthly family income, average academic performance, frequency of getting absent to school, working status of mother, frequency of consuming junk food for the breakfast, frequency of consuming junk food for the lunch break, habit of consuming lunch after getting back from school, frequency of consumption of fruits, frequency of consumption of sweet items and parents intention on having a special concern about child's meal when compared to the usual meal of the family. The statistical model prepared by using binary logistic regression indicated that, having a low weight at birth, child's mother being a housewife and child does not having a regular habit of consuming lunch after getting back from school as the significant predictors of future risk of undernutrition ($p < 0.05$). Thus the present study provides preliminary data to predict nutrition-related health issues among children in Ampara district, Sri Lanka.

Keywords: *Diet, nutrition, socio-economic factors, statistical model*

[1]Department of Zoology,Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila,Nugegoda,Sri Lanka.
[2] Department of Statistics, Faculty of Applied Sciences, University of Sri Jayewardenepura,Gangodawila,Nugegoda,Sri Lanka.

Exploring Different Recipes of the traditional 'Diyabath' Preparations used in Sri Lanka

A.H.G.S. Udari[1], T. Thoradeniya[2], S. Jayasena[2], C. Arambepola[3], H. De Silva[4], D. Thoradeniya[5], V.P. Wickramasinghe[6]

'Diyabath' (fermented cooked rice) is not only a potential nutritious food, but also a sustainable food as it uses the surplus of dinner for next day breakfast. In recent years, the consumption of fermented foods containing live microorganisms has emerged as an important dietary strategy for improving nutrient bioavailability and human health. Indigenous medical practitioners (IMP) in Sri Lanka recommend 'Diyabath' as a dietary solution to improve gut and overall health. So far, no deep exploration has been reported on this traditional food and its potential health benefits. The objective of the survey study was to explore different recipes of 'Diyabath' to be used in an intervention based further investigation aiming health promotion in Sri Lanka. Two surveys of diyabath consumers (n=30) and IMP (n=38) were conducted as cross-sectional pilot surveys based on 'Key informant method' to discover the preparational methods practiced by the community as well as recommended by the IMP for ailments. Participants were purposively recruited representing different rural areas in Sri Lanka. To prepare diyabath, community preferred Kekulu (raw) rice whereas 34% IMP recommended traditional rice varieties which have proven remarkable improvement of amino acids and antioxidant activity in rice based fermented food. Both community and IMP agreed with the clay pot to carry out the overnight fermentation in which, bacteria are found to thrive better. The highest percentages of community agreed that the overnight fermentation duration should be 8-10hrs, eventhough literature confirms 12hrs rice fermentation increases protein and micronutrients (Fe, Zn, Mg, K etc) contents and obtained highest scores for all sensory attributes comparatively. After the fermentation, 56.7% consumers preferred straining water and add other ingredients before eating diyabath, whereas 31.6% IMP recommended not to strain water as it could contain probiotics. Altogether, the study discovered 19 different ingredients and 08 different methods of preparing 'Diyabath'.

Keywords: *Diyabath, Fermented cooked rice*

[1]Faculty of Science, Horizon Campus,
[2]Department of Biochemistry & Molecular Biology, University of Colombo
[3]Department of Community Medicine, University of Colombo
[4]Institute of Indigenous Medicine, University of Colombo
[5]Department of History, University of Colombo
[6]Department of Pediatrics, University of Colombo

Assessment of nutritional status of cancer patients: A hospital based descriptive cross-sectional study

D.R.D.S.M.S. Bandara[1], E.De Zoysa[2]

Nutrition is an important factor in the management of cancer patients and malnutrition is a common and under-recognized problem among them. This study was conducted to assess the nutritional status of cancer patients in the Oncology Unit of Teaching Hospital, Karapitiya. 425 subjects who were on treatment and on follow up, enrolled in the study with the informed consent by using convenient sampling method. Socio demographic data was collected by using an interviewer-administered questionnaire. Sinhala version of Patient Generated Subjective Global Assessment - Short Form (PG-SGA SF) was used to assess the nutritional status. Data were analyzed by using descriptive statistics and the Pearson's chi-square test ($p<0.05$). Ethical approval for the study was obtained from the Ethical Review Committee of the Faculty of Allied Health Sciences. There were 285(67%) females and 140(33%) males. The age of majority of the subjects (n=336, 79%) was 51 years or above. Among them, 168 subjects (39.5%) had cancers in the digestive tract and 110 (25.9%) had breast cancers. Duration from the primary diagnosis was more than six months in majority (n=294, 69%) of subjects and 170 (40%) were on chemotherapy at the time of data collection. Majority of the subjects (n=234, 55 %) had moderate or severe malnutrition and only 191 (45%) of subjects were well nourished. Out of the subjects with cancers of digestive tract (n= 168), majority (n=87, 54.8%) were moderately or severely malnourished. Among who had breast cancers (n=110), majority (n=57, 51.8%) were well nourished. The correlation between the nutritional status and the mode of treatment ($p<0.003$) and the correlation between nutritional status and duration from the primary diagnosis ($p< 0.001$) were statistically significant in this study sample. Considerable proportion of cancer patients were moderately or severely malnourished. Early detection of nutritionally at- risk patients and timely intervention might help to optimize the management of cancer patients.

***Keywords**: cancer, nutritional status, PG-SGA SF*

[1]Department of Nursing, Faculty of Allied Health Science, University of Ruhuna, Sri Lanka.
[2]Department of Bio Chemistry, Faculty of Medicine, University of Ruhuna, Sri Lanka.

Pregnant women's knowledge, attitudes, practices towards nutrition and their association with nutritional status: A Tertiary Care Centre study in Sri Lanka

D.M.I.T Fernando[1], W.T.S.R Fernando[1], D.S.K Gamage[1], U.S.K Gamage[1], H.M.P Ghanuka[1], C.M Wickramatilake[2]

Pregnancy is a critical period where nutrition plays a paramount role. Maternal knowledge and attitudes on nutrition and dietary practices may influence the health and the nutritional wellbeing of both mother and the baby. The objectives were to describe the maternal knowledge, attitudes, and practices on food and nutrition and to determine their association with the weight gain of pregnant women admitted to Teaching Hospital, Mahamodara. It was a descriptive cross-sectional study which included 325 pregnant women in their third trimester. Data were collected through an interviewer-administered questionnaire and weight gain during pregnancy was assessed after informed written consent. Scores were calculated appropriately for nutritional knowledge, attitudes and practices during pregnancy. Chi-square test was used to test the association between variables at the significance level of 0.05.

Majority (53.5%) of them had a normal BMI at their first clinic visit. Adequacy of weight gain of each pregnant woman was considered according to their pre-pregnancy BMI and preponderance of pregnant women (72.3%) had achieved this by the end of the third trimester.

Mean nutritional knowledge score was 44.3 and 18.2% had scored above the average. Among them, 50.8 % (n=165) had a score below the average of attitude score on food and nutrition indicating that majority did not believe in myths. There was no significant association between weight gain and knowledge (p=0.163) and attitudes (p=0.412). Dietary practices were not satisfactory among 76% (n=247) during the first trimester and showed significant association with the overall weight gain (p=0.027). There were 67.6% (n=220) women whose dietary practices were not satisfactory throughout the pregnancy and a significant association was observed between dietary practices throughout pregnancy and weight gain during the pregnancy (p=0.016).

In conclusion, majority of the pregnant women had an adequate weight gain. However, pregnant women's knowledge, attitudes and practices towards nutrition in the selected areas were low. There was a significant association between food practices and the weight gain during pregnancy. Therefore, community nutritional education and antenatal nutritional counselling need to be strengthened in the area.

Keywords- *Attitudes, Food practices, Nutritional knowledge, Pregnancy, Weight gain*

[1]Faculty of Medicine, University of Ruhuna,
[2]Department of Biochemistry, Faculty of Medicine, University of Ruhuna

Generation of Food-Based Recommendations to achieve micronutrient requirements for women and preschool children using linear programming approach (Optifood)

B.G.P.S.K. Wickramawardhane[1], K.A.C. Madumali[1], J. Thamilini[1] and K.D.R.R. Silva[1]

Women and preschool children in developing countries are at high risk for inadequate intakes of multiple micronutrients due to poor dietary practices. The present study aimed to (i) investigate the current food consumption patterns of Sri Lankan women and preschool children (ii) identify micronutrients that are difficult to achieve Recommended Nutrient Intake (RNI) using current dietary patterns and (iii) formulate realistic food-based recommendations (FBRs) to improve dietary adequacy. Secondary data analysis was done using interviewer administered 24-h dietary recalls from a national-level cross-sectional study (2016) to assess the weekly food consumption patterns of 1000 women and child pairs of rural, urban, and estate populations focusing on their intake of 11 selected micronutrients (vitamin C, thiamine, riboflavin, niacin, vitamin B_6, folate, vitamin B_{12}, vitamin A, calcium, iron, and zinc). Two specific sets of FBRs for women and preschool children were developed by linear programming analysis using WHO Optifood software. Dietary patterns of women showed that calcium, thiamin, riboflavin, niacin, folate, vitamin A, and iron were the problem nutrients (i.e. 100% RNI cannot be achieved even when the optimum diets are consumed). Only niacin and vitamin A were the "problem nutrients" among preschool children. Green leafy vegetables, vitamin A-rich fruits and vegetables, starchy roots, legumes, dairy products, meat, fish, and eggs were identified as potential nutrient-dense foods for both women and preschool children that would fill the nutrient gaps. In the modeled optimized diets using currently consumed foods, the best-consolidated set of FBRs for women ensures dietary adequacy (at least achieving 65% RNI in the worst-case scenario) only for vitamin B_6, vitamin B_{12}, and zinc, and for preschool children, only calcium, riboflavin, vitamin B_6, vitamin B_{12}, iron, and zinc. In conclusion, women and preschool children have difficulty in meeting nutrient recommendations using locally available foods. Modeling possible FBRs would not adequately address micronutrient deficiencies. Therefore, micronutrient supplementation, food fortification, and provision of nutrition intervention programs are suggested to increase the nutrient adequacy.

Keywords: *Food-based recommendations, Linear programming, Women, preschool children, Problem nutrients*

Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.

ABSTRACTS OF POSTER PRESENTATIONS

Evaluation of impact of nutritional counseling on nutritional status of post-operative coronary artery bypass graft surgery patients

M. K. D. O. Warunika[1], A. M. N. T. Adikari[1], and F. A. Z. Firouse[2]

Modifying the diet via nutritional counseling is an emerging concept used to intervene in nutrition imbalances that lead to malnutrition, chronic diseases, and other clinical conditions. In surgical patients, nutritional counseling supports fast recovery and reduces complications after surgery. Coronary artery bypass graft (CABG) surgery is used to treat cardiovascular diseases, which are increasing in Sri Lanka. However, studies determining the effect of nutritional counseling on CABG patients in Sri Lanka are limited. This cross-sectional study was employed to evaluate the impact of nutritional counseling on the nutritional status of post-operative CABG patients. Thirty post-operative CABG patients (Males; 20, Females; 10), age >18 years were recruited from a private hospital. Post-operative nutritional counseling was provided at the hospital by a registered dietitian. Observations on nutritional counseling, patients' information sheets available with the dietitian, and a pre-tested interviewer-administered questionnaire via telephone were used for data collection. At baseline, data were collected on patients' general characteristics, medical information, nutritional status-related biochemical parameters, and dietary information. The impact of nutritional counseling was determined using the improvement of biochemical parameters and dietary habits from the post-operative stage to the first hospital after the surgery and wound healing time period of patients. Findings confirmed improved biochemical parameters from high levels to a healthy range for random blood glucose levels and serum albumin levels in 20% and 16.7% of patients respectively. Serum albumin level of 33.3% of patients was improved from a low level to a healthy range. The length of the wound healing period (Mean 3.07+1.2 weeks) was less than two weeks for 36.7% of patients. Vegetable consumption of 33.3% of patients was increased from <2 servings to 2-4 servings per day. According to the results, nutritional counseling positively impacted on nutritional status of post-operative CABG patients. Further studies should be performed on the impact of nutritional counseling on other surgical procedures.

Keywords: *Cardiovascular diseases, Coronary artery bypass graft surgery, Nutritional counseling, Nutritional status, Post-operative*

[1] Department of Applied Nutrition, Wayamba University of Sri Lanka, Makandura. Gonawila, Sri Lanka.
[2] Department of Dietitian, Asiri Surgical Hospital, Colombo, Sri Lanka.

Food literacy status of secondary school children in Bandarawela education zone and its correlates

W.K.S.H. Weerasekara[1], M.P.S. Rathnayake[1], K.D.R.R. Silva[1], J. Nanayakkara[2], T. Perera[1], A. Worsley[3], and A.O. Booth[2]

Food literacy (FL) plays a major role in inculcating healthy dietary behaviors from youth, which has been considered the ideal way to address the triple burden of malnutrition and risky behavior of non-communicable diseases. FL level of Sri Lankan school children has not yet been determined using an appropriate tool although it is important to understand the gaps in their food literacy. The aim of this study was to assess the food literacy of 14-15-year-old (grades 9 and 10) school children by employing a food literacy assessment tool that was recently developed and validated for secondary school children in Sri Lanka. Data were collected from a convenient sample of grade 9 and 10 students recruited from different types of schools (1AB schools: grades 1-13 with Advanced Level Science stream, 1C schools; grades 1-13 without Advanced Level Science stream, and Type 2 schools: grades 1-11 only) in the Bandarawela education zone using the maximum variation sampling technique. The employed assessment tool was composed of two sections; (i) Demographic information and (ii) 24 questions (items) under 7 food literacy domains. Two hundred and eighty-two students (43.2 % females, and 56.7 % males) completed the survey. The mean $\pm$ SD food literacy score of the sample was 76 ± 9 (out of 100). Gender and ethnicity were significantly associated with the overall food literacy scores ($p<0.05$). Females were more food literate than males, and Sinhalese students scored higher than Tamils and Muslims. Subscale scores of eating, knowledge, and emotions domains were significantly different between ethnicity and school types, whereas both father's and mother's education were associated with skills and knowledge domains. In conclusion, overall food literacy level of the children is satisfactory. This data will be useful for designing programs to address gaps in food literacy and to develop school curricula and nutrition-related policies.

***Keywords**: Assessment, Food literacy tool, Secondary school children, Sri Lanka*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka.
[2] Institute for Physical Activity and Nutrition (IPAN), School of Exercise and Nutrition Sciences, Deakin University, Melbourne Burwood Campus, 221 Burwood Highway, Burwood VIC 3125, Australia.
[3] School of Exercise and Nutrition Sciences, Deakin University, Geelong, VIC, 3220, Australia.

Elevating photo-based food journaling to a next-level smartphone app for meal tracking and self-reflection among Sri Lankan adults

P.P Weerasinghe[1] and T. Perera[1]

Photo-based food journaling which is using photographs to track dietary intake via apps is common. But still elusive in Sri Lanka. Moreover, it can be used to promote SMART (Small, Measurable and Achievable Dietary Changes to Reduce Unhealthy Food and Trying Healthy Food) eating which is timely in Sri Lanka. This study aimed to explore the effect of photo-based food journaling on self-reflection, self-assessment on SMART eating, and food choice intention in adults while developing a novel meal-tracking application named SnaT (Snap & Track) in the Sri Lankan context. The sequential explanatory mixed method was used. A convenient sample of 25 adults was asked to complete a 3-day photo-based food journal on 2 weekdays and 1 weekend day, followed by additional three days using the SnaT. The data were collected via telephone interviews in August 2021. The mean age of participants was 24±6.08 years, and 80% were female. A significant increase was observed in the consumption of a variety of healthy food [fruits and vegetables (p=0.00), legumes (p=0.001), fish, meat and poultry (p=0.00), eggs (p=0.00), and milk (p=0.001)] and a decline of consumption of unhealthy food [salt (p=0.025), sugar and sweet food (p=0.00)]. The busy lifestyle was the primary challenge for SMART eating and 76% (19/25) accepted photo-based food journaling to rectify it. Enhancing self-awareness on meals was identified as the major benefit of photo-based food journaling (18/25; 72%) while forgetting to capture photos before eating was the main barrier (17/25; 68%). The SnaT was well-received (21/25; 84%) as very appropriate to Sri Lanka and has proven to reduce the burdens inherent to manual photo-based food journaling. However, further research should warrant acceptance of the SnaT on different demographic groups by remodeling the app by including features of Digi-tech nutrition education and Nudging techniques to encourage healthy eating.

Keywords: *Adults, Meal tracking app, Photo-based food journaling, Self-reflection, SMART eating*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170, Sri Lanka.

Availability of specific nutrition guidelines for middle childhood (5-10y) nationally and globally

Kavindya Bandara [1], Roshan Delabandara[2], Anoma Chandrasekara [1,2]

Good nutrition during middle childhood (5-10y) is important and should be emphasized. Strong responsive policies and guidelines are vital to operationalize effective interventions to improve middle childhood nutrition. The aim of the study was to review the existing nutrition guidelines for middle childhood nationally and globally. Published nutrition/dietary guidelines from several countries were examined. Information was sourced from the Food Based Dietary Guidelines (FBDGs) repository of the Food and Agriculture Organization (FAO). The repository includes FBDGs for 86 countries. The available information and nutrition guidelines for middle childhood (5-10y) were extracted. Only the information published in English was considered irrespective of the date of publication.

The results showed that 21 out of 86 countries have addressed middle childhood nutrition through FBDG. In Asian region, Bhutan published specified dietary guidelines for middle childhood. Philippines and New Zealand address this age nutrition through FBDG. South Africa, Kenya, Benin, Sierra Leone and Nigeria from African region, Austria, Belgium, France, Spain, Switzerland, Albania and Cyprus from Europe, Bolivia, Grenada, Guatemala and Paraguay from Caribbean region and Oman from Near east and USA address middle childhood nutrition through FBDG. Though some countries haven't address middle childhood nutrition through FBDG, they have reached this age group nutrition through other interventions. In Sri Lanka; Food and nutrition policy for schools published by WHO, Manual on school nutrition program published by the ministry of education Sri Lanka, and FBDG Sri Lanka are implemented in terms of middle childhood nutrition. But there are no specifically focused guidelines for middle childhood currently in Sri Lanka.

In conclusion, though no specific nutrition guidelines aimed at middle childhood in Sri Lanka, around ¼ of other countries have middle childhood nutrition guidelines. These findings may serve as the basis for the development of nutrition guidelines for middle childhood to enhance the nutritional status of the respective age segment in other countries including Sri Lanka.

Keywords: *Dietary guidelines, Middle childhood nutrition, Primary school child nutrition*

[1]Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.

[2] Nutrition Society of Sri Lanka.

Effectiveness of *Mau shaeer muhammar* (Roasted Barley water)- A Unani formulation in the Management of respiratory tract infections.

M.A.F. Bushra[1], M.R.F. Rifna[1]

Respiratory tract infections are the most common infectious disease, with mild to fatal symptoms affect without age limitation. Microbes play vital role in its pathogenesis.*Mau shaeer* (Barley water) has prescribed as a dietary supplement for most of the infectious diseases by Unani Physicians. It has several preparation methods in vary to its actions. Aim of this study was to confirm therapeutic uses of *Mau shaeer muhammar* in the management of respiratory tract infections by reviewing the Unani Classical Literature along with modern research studies.This study was conducted as a systematic literature review on 286 peer reviewed index articles published during 2012 to 2022 with titled therapeutic effects or nutritional value or pharmacological actions or chemical compositions of barley water collected through search engines Mendeley PubMed and google scholar and 5 Unani classical literature were scrutinized and compiled the data with comparison to the Unani and Modern aspect in the management of the respiratory tract infections. Articles based on agriculture, commercial and other aspects were excluded.According to Unani aspects barley water can be prepared in three ways. Roasted barley water is more in the treatment of respiratory tract disorders. It consists dietary fiber B-glucans, amylose, lipid, protein, carbohydrate, iron, ash, calcium, phosphorus, magnesium, and phenolic compounds. It is responsible for antibacterial, antiviral, antifungal, antioxidant, immune modulatory anti-inflammatory, and antitussive activity. The compositions polysaccharides, proteins, and other minerals along with their antibacterial, antiviral, antioxidant and immune modulatory actions play a vital role for the symptomatic relieve and restore the health after respiratory tract infections. Hence it is concluded, *Mau shaeer Muhammar* is a potent dietary supplement during infectious diseases still require clinical studies.

Keywords*: Barley water, Mau shaeer, Respiratory tract infections, Dietary supplement*

[1]Institute of Indigenous Medicine, University of Colombo

Intake of unhealthy food and associated factors among government office workers in Galle district

G J Chandana[1], C J Wijesinghe[2]

Office workers are at a higher risk of developing Non-Communicable Diseases (NCD) due to the sedentary nature of their work. Unhealthy dietary practices can further increase the risk for NCD among this specific group. This study aimed to assess intake of sugary/salty snacks and sugar sweetened beverages among office workers in Galle district and factors associated with it. A cross-sectional study was conducted among government office workers in twenty selected offices in Galle District. Data on socio-demographics, personal or family history of NCD, work-related data and dietary practices were collected using a self-administered questionnaire. Dietary intake was assessed using 24-hour dietary recall, supplemented by an image guide for food quantities. A computer software was used to calculate number of servings as specified in Food Based Dietary Guidelines for Sri Lankans (2nd edition). Five hundred and eighteen office workers participated in the study (response rate=84.9%). Mean intake of unhealthy food among office workers was two servings/day and only 190 (36.7%) participants have consumed one or less serving/day of unhealthy food. Meal skipping at work (*P*=0.02) and eating as a group (*P*=0.001) were associated with having unhealthy foods above the recommended level per day. Unhealthy food intake showed a non-significant association with obesity (*P*=0.86). None of the socio-demographic and work-related factors or health conditions was associated with increased consumption of unhealthy foods. Intake of unhealthy foods and beverages is high among office workers in Galle District and is associated with group eating and meal skipping. Nutrition education and health promotion interventions are recommended to reduce the diet related NCD risk among office workers.

Keywords: *Dietary practices, Office workers, Unhealthy foods*

[1]Lecturer, Department of Community medicine, Faculty of Medicine, University of Ruhuna
[2] Professor / Head, Department of Community medicine, Faculty of Medicine, University of Ruhuna

Evaluation of Textural and Physiochemical properties of *Lasia spinosa* (kohila) incorporated Shelf Stable Multipurpose Food Cube

S.P.M Sugathapala[4], M.H.T.K Chandrasiri [2], S.D.R Lakmal [3] and J.K.H Sampath [4]

Food cubes are processed food products popular among consumers although health concerns have aroused regarding their constituents. Therefore, selection of appropriate ingredients, formulation and development of multi-purpose food cubes that combat against adverse health effects is highly beneficial for the consumers. *Lasia spinosa* (kohila) is one of the indigenous vegetables considered to have health benefits over the intended nutrition due to its antioxidants and dietary fiber content. Aim of this study was to develop an instant food cube recipe and to evaluate its nutritional properties. Sliced kohila was freeze dried at -84ºC for 6 hours and dehydrated kohila blended to produce flour. Blanched, sliced fresh kohila roots and dehydrated kohila flour were mixed in 2:1 (T_1), 1: 1 (T_2) and 1: 2 (T_3) ratios as the three treatments. Developed Food cubes and commercially available cubes were used to prepare a dhal curry prior to serving the panelists. Food cube from T_3 was selected to be the best after initial sensory evaluation for further analysis. Proximate analysis revealed that T_3 sample had 17.4g ± 0.45/100g protein content, 3.7g ± 0.23/100g fats and 15.4g ± 0.43/100g dietary fiber. Based on highest estimated median score (9) and comments of sensory panelists, incorporating herbs and dehydrated kohila flour have significantly increased the acceptability of this food cube compared to the commercially available multipurpose food cubes. Microbiological evaluations denoted that, yeast & mold count and the total viable plate counts were within the stipulated limits given by WHO for storage of 21 days. Enumeration of coliforms was not detected for any food cube. T_3 had total phenolic content of 99.79 ± 1.26 mg/ g and total antioxidant activity of 107.29 ± 1.44 µg/ g. Considering the outcome of the analysis the product from T_3 showed better nutritional properties compared to the commercially available food cubes.

Keywords: *food cube, flavor enhancers, kohila, Lasia Spinosa, soup cube*

[4,2,4] Department of Biosystems Technology, Faculty of Technological Studies, Uva Wellassa University, Passara road, Badulla, Sri Lanka.
[3] Department of Engineering Technology, Faculty of Technological Studies, Uva Wellassa University, Passara road, Badulla, Sri Lanka

Factors influencing the food choices of preschool children in middle-income countries: A systematic review

U.P.T.D. Chandrasiri[1] and M.S.F. Sirasa[1]

Double burden of malnutrition has increased globally and highly prevalent in middle-income countries. Modifying dietary behaviors via interventions is necessary to improve the nutritional status of children. Since the primary caregiver is responsible for child food choices, understanding their perspectives on factors influencing children's food choices is vital to promote healthy eating. The current study aimed to systematically review the primary caregiver perception of factors influencing the food choices of preschool-aged children in middle income countries.

Articles were sourced using keywords via PubMed, Cochrane Library and Emerald Insight databases published prior to August 2021. Using PICOS inclusion and exclusion criteria, studies were screened according to the PRISMA guidelines. Studies published in English that involving of a primary caregiver perception or opinion on food choices of healthy preschool children aged 2 to 6 years, conducted in middle income countries were included. General reviews, book chapters and newspaper articles were excluded. The quality of the selected studies was determined by quality criteria checklist of Academy of Nutrition and Dietetics. In total, 40 studies published between 1988 and 2021 were eligible for inclusion. Thirty-three different factors were identified and categorised in to three main categories based on Bronfenbrenner's Ecological System Theory were: individual child factors; family and peer factors; and external environmental factors. Family and peer factors reported mostly (n=36 studies), followed by individual child factor (n=9 studies) and external environmental factor (n=8 studies). Most frequently reported family and peer factors were; nutritional knowledge of the family, family income, maternal education level and maternal employment. Additionally, food preference of child was also reported frequently.

In conclusion, family and peer factors and individual child factor of child's food preferences should be considered when designing interventions to promote healthy food choices in preschool-aged children living in middle-income countries.

Keywords: *Factors, Food choices, Middle income, Preschool children, Primary caregivers.*

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Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.

Biochemical and Physiological Changes of Artificially and Naturally Ripened Karthakolomban Mangoes

M.H.T.K. Chandrasiri[1], K.B. Wijesekara[5], P.G.S.R. Wijetunga[6] and K.D.R.R. Silva[7]

Karthakolomban (*Mangifera indica* L.) is one of the most consumed mango cultivars in Sri Lanka which provide an excellent source of minerals, dietary fiber, and bioactive compounds such as vitamin C and phenolics. These are often ripened artificially to meet the increasing consumer demand. Hence, changes in the biochemical characteristics during the ripening of Karthakolomban were investigated comparing natural and ethephon-treated artificial ripening systems. Karthakolomban, grown in the Dry Zone of Sri Lanka, harvested at 90 days after full bloom were used. Well-cleaned fruits (n=100) and 3 replicates per treatment were stored at ambient conditions (32-35 °C, RH 90-95%) for natural ripening while another batch was kept in a chamber with 5 mL of ethephon-NaOH mixture for 24 hours. Important biochemical and nutritional parameters of mangoes were evaluated at two days ripening intervals and analyzed with t-test. Untreated fruits were fully ripened after 98 days from full bloom stage where ethephon treated fruits were over-ripened. Ethephon-treated mangoes had significantly lower antioxidant activity (67.68 ± 1.64 µg/mL) as per 2,2-diphenyl-1-picrylhydrazyl/DPPH assay and Vit-C content was (12.9 ± 0.52 mg/100g) while the naturally ripened sample had 19.8 ± 0.95 mg/100g of vit-C. After 08 days of harvesting, antioxidant activity of both samples has significantly reduced. Significantly higher ($p<0.05$) total phenolic content was found in naturally ripened samples (97.8 ± 0.21 mg GAE/g) than the ethephon treated sample (53.4 ± 0.44 mg GAE/g). Dietary fiber content was significantly higher in the artificially-ripened-mangoes (2.1-2.6 g/100g) throughout the shelf-life compared with the naturally ripened mangoes (1.4-1.8 g/100g). Pulp pH and Total Soluble Solids were found to be significantly increased in artificially-ripened-mangoes while peel firmness and stickiness were also significantly influenced. In conclusion, this study shows a significant effect in the biochemical composition of Karthakolomban when ethephon is used compared with natural ripening.

Keywords: *Artificial ripening, biochemical changes, ethephon, food security, karthakolomban*

[51] Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.
Department of Biosystems Technology, Faculty of Technological Studies, Uva Wellassa University, Passara road, Badulla, Sri Lanka.
[6] Department of Engineering Technology, Faculty of Technological Studies, Uva Wellassa University, Passara road, Badulla, Sri Lanka.
[7] Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka. Makandura, Gonawila 60170, Sri Lanka.

Relationship of body mass index, skinfold analysis and bioelectrical impedance analysis in evaluating body fat percentage of national athletes in Sri Lanka

U.N.J. Dahanayake [1], G.L.K.Ekanayake[1] , W.D.W.Senanayake[1], K.D.R.R. Silva[2] and A. Chandrasekara[2]

In sport, body composition is often estimated by measuring the thicknesses of various skinfold sites on the body and bioelectrical impedance analysis (BIA) which give an estimation of fat mass and fat-free mass. Body Mass Index (BMI) is a commonly used index of relative weight to height. However, there is limited data available on this area hence, this study was carried out to determine the relationship of BMI and body fat percentages (BFP) analyzed by skinfold thickness (SFT) and BIA of national athletes in Sri Lanka. Fifty athletes representing different sport categories (sprint, middle distance running, marathon, relay, long jump, high jump, javelin throw, table tennis, badminton, weightlifting and karate) were assessed for anthropometric measurements including height and weight and body composition measurements including subcutaneous fat mass, visceral fat level, fat-free mass, muscle mass, skeletal muscle mass, bone mass and body water content. SFT measurements were taken using skinfold calipers on triceps, bicep, subscapular, supraspinal, abdominal, mid-thigh, mid-calf, ileo-crestal, chest and mid axillary and BFP was calculated using "Siri's equation". BFP values obtained using two methods were compared by paired t-test. Mean weight of the study sample was 63.8 kg (SD 21.1), mean height was 1.67 m (SD 0.09) and the mean age was 27 years (SD 5.7). Among fifty athletes, 44% were in normal BMI range (18.5 kgm^2-22.9 kgm^2). The mean skeletal muscle mass was 44.7 kg (SD 5.32). There was no significant difference between BFP obtained using SFT method (mean 17.86 ±10.18) and BIA method (mean 18.36±9.78). Moreover, there is no significant relationship between BMI and BFP. In conclusion, athletes' BFP measured using BIA and SFT are independent of BMI. BMI, like all anthropometric measurements, is only a surrogate measure of body fatness. Therefore, practical use of these tools needed to be revisited and extended studies are required.

Keywords: *Athletes, Bioelectrical impedance analysis, Body composition ,Body mass Index, Skinfold thickness.*

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[1] Institute of Sports Medicine, Ministry of Sports and Youth affairs, Sri Lanka.
[2] Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.

Nutritional status and the association of physiological and psychological changes on food habits of older adults

D.R.P.M. Danasekara[1] and R.M.T.K. Ranathunga[1]

Various physiological and psychological changes take place during ageing. Impairments can be seen in food intake, digestion, absorption, and metabolism which cause, the increased risk of under-nutrition. This study aimed to identify the nutritional status of older adults and to identify the association between physiological and psychological changes in eating behaviors in older adults. A cross-sectional study was conducted by recruiting 100 community-dwelling older adults (41 males and 59 females). Information on socio-demographic factors, physiological, psychological changes, and food habits such as vegetarianism, texture of the foods, meals skipping, handling of foods, amount of foods consumed was collected using an online questionnaire with the help of caregivers of the older adults. The Mini Nutritional Assessment was used to assess the nutritional status. Food Frequency Questionnaire was used to determine the frequency of consumption of main food groups. The mean age of the study participants was 72.0 (SD 6.1) years. Only 3% of older adults were malnourished while 44% of participants were at risk of malnutrition. The highest consumption frequency was reported for cereals and starchy roots (10 times per week) followed by vegetables (6.8 times per week) and legumes and pulses (4.7 times per week). The lowest consumption frequencies were reported for fruits (3.1 per week), meet, fish and eggs (3.6 times per week) and dairy products (3.9 times per week). Problems related to gastrointestinal tract ($p=0.035$) and muscle function ($p<0.0001$) were the physiological factors that significantly associated with food habits. Poor memory ($p=0.015$) was the psychological change that significantly associated with the food habits. In conclusion, the percentage of older adults with malnutrition is very low in the selected population, while nearly half of the population was at risk of malnutrition. Gastrointestinal problems, poor muscle function and poor memory were associated with food habits of older adults.

Keywords: *Food habits, nutritional status, older adults, physiological and psychological changes*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170 NWP, Sri Lanka.

Formulation and Characterization of Edible Packaging Material from Corn (*Zea mays l.*) Hull and Catla (*Catla catla*) Fish Scales

H.M.W. Dilrukshi[1] and M.C.N. Jayasooriya [1]

There is a significant interest within the global community on edible food packaging to add an additional nutritive value to the packaged-food while overcoming environmental and food safety complications adhered with synthetic polymer materials. This study was aimed to develop an edible packaging film with corn hull (*Zea mays l.*) and Catla (*Catla catla*) fish scales which are underutilized, renewable resources though they are still wastes. Three packaging films were developed (with 100% corn hull, 75% corn hull with 25% Catla fish scales and 25% corn hull with 75% Catla fish scales). Films were characterized in terms of film-forming ability, mechanical, barrier, thermal, microbiological, and sensory properties. The highest swelling degree (165.34±8.42%), L* value (71.39±0.19) and transparency were recorded with 100% corn hull incorporated material. The highest water uptake at any t–time and water solubility (42.68±5.90%) were showed by 75% Catla fish scales incorporated material. The rupture test results determined that the fracturability increased with Catla fish scales incorporation and the highest value (450.53±3.83 g) in 1% of load sensitivity was recorded with the material in which 75% Catla fish scales incorporated. The fracture deformation was significantly affected (p<0.05) by the Catla fish scales incorporation which revealed that there was a significant increase of elasticity of the film. The same material recorded the highest total solid (86.74±0.23%) and crude protein (16.96±0.01%) contents in proximate analysis while the 100% corn hull incorporated material showed the highest crude fat (2.54±0.05%) and crude fiber (20.40±0.42%) contents in dry weight basis. In sensory evaluation, 100% corn hull material obtained the highest overall acceptability through a semi-trained panel. All the three materials showed negative results for the coliform test. Study results evidenced that the 100% corn hull material had desirable mechanical and physicochemical properties which is more suitable for edible food packaging applications.

Keywords: *Corn hull, Edible food packaging, Fish scales, Waste utilization.*

[1]Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka.

Sugar Profile of Bee Honey of *Apis cerana* from Selected Geographical Locations in Sri Lanka

W.G. Dinushi[1], G.M. Somaratne[2], P.P.A.J. Rathnayake[3], B.A.D.H. Beligala[4]

Sugars are the primary components of bee honey which account for about 95% of the dry weight. Nevertheless, the glycemic index of bee honey (58) is lower compared to table sugar (65) and bee honey consumption does not cause blood sugar levels to rise as rapidly as sugar intake. Therefore, it is indeed important to identify the beneficial significance of consuming bee honey as a table sugar substitute. The objectives of this study were to determine the sugar profile of bee honey from different geographical regions which were chosen based on areas that are suitable for beekeeping practices in Sri Lanka and to determine consumer preferences. The sugar profile was analyzed for reducing sugars, apparent sucrose, the ratio of fructose to glucose and solid content. The quantitative data were subjected to normality testing and LS-means separation under General Linear Model. Thirty sensory panelists were used in an organoleptic assessment based on five different parameters to evaluate consumer preference. Reducing sugar, apparent sucrose, fructose to glucose ratio and solid content significantly varied with the geographical location. Honey sample from Awissawella had the highest reducing sugar content (65.50±0.06) whereas Uva-Paranagama sample had the highest apparent sucrose content (18.88±0.92). The highest fructose/ glucose and the highest solid content were detected in Nuwaraeliya (0.50±0.01) and Badulla (75.43±0.55) samples, respectively ($P<0.05$). The organoleptic parameters were significantly different ($P<0.05$)) among bee honey samples from different locations. According to the taste panel, 80% of the subjects preferred the bee honey sample that had the highest reducing sugar content. Climate and floral origin could be major reasons for parameter variations with respect to the location. This study provides preliminary data for the possibility of developing honey as a substitute for table sugar to target pancreatic beta cells that produce insulin as a preventive measure of type 2 diabetes.

Keywords: *Fructose to glucose ratio, Organoleptic parameters, Reducing sugar, Sucrose*

[1] Department of Molecular Biology and Biotechnology, Faculty of Science, University of Peradeniya, Sri Lanka.
[2] Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka.
[3] Division of Applied and Natural Sciences, University of Vocational Technology, University College of Matara, Sri Lanka.
[4] Department of Neurology, Health Science Campus, University of Toledo, Toledo, Ohio, United States.

Production of arrowroot (*Maranta arundinaceae)* flour incorporated low-fat ice cream with natural colorant and determination of physicochemical and sensory properties

K.P.W.C. Hansani[1], S.M.A.C.U. Senarathne[2], M.H.T.K. Chandrasiri[1], J.K.H. Sampath[1]

Arrowroot plant is a tuber crop rich in starch with lower Glycemic Index (GI). Thus, food use of arrowroot enhances the possibility to combat type 2 diabetes. Moreover, arrowroot rhizome has high amounts of potassium, magnesium, iron, calcium, and fructo-oligosaccharides. Arrowroot is used as an ingredient in production of gluten-free products with the best nutritional and sensory quality such as ice cream stabilizers and infant formula in the global context. However there is a scarcity of reported scientific studies on application of arrowroot powder in production of non-fat ice cream. Dehydrated arrowroot powder was obtained using a cabinet dryer. Beetroot (*Beta vulgaris*) and butterfly pea (*Clitoria ternatea*) extracts were used as natural colorants, wherein the control no colorant was used. Initially, seven samples were developed based on arrowroot powder concentration (1.25%, 2.25%, 3.25%) using two colorants. Prior to the sensory evaluation, microbiological properties were evaluated with the total viable plate count, *Escherichia coli,* yeast and mold count, and salmonella counts. Arrowroot powder and butterfly pea 2.25% combination was the best incorporation level based on the sensory evaluation. Proximate analysis recorded that ice cream developed from arrowroot powder and butterfly pea extract had 1.5±0.00% fat, 2.3±0.00% protein, 1.9±0.00% dietary fiber, 32.9±0.00% total solids, 5.82-6.62 range of pH, 0.26 ± 0.01 $gms^{-1,}$ meltdown rate, 12.1% milk solids non-fat, 0.14 ± 0.20% titratable acidity, 29.7 ± 0.01total soluble solids, 88.4 ± 0.8% IC_{50} value and 5.2 mg/g total phenolic content. The developed products were compared with the Sri Lanka standards for low-fat ice cream products. The shelf life of the developed ice cream was up to 3 months at -18^{o}C storage temperature without using any artificial preservatives.

Keywords: *Arrowroot, Colorant, Ice cream, Low fat, Low Glycemic Index*

Department of Biosystems Technology, Faculty of Technological Studies, Uva Wellassa University of Sri Lanka.
[2] Food Research Unit, Department of Agriculture, Gannoruwa, Peradeniya, Sri Lanka

Socio-demographic and health related factors associated with nutritional status in children less than five years in selected rural communities in Sri Lanka

H.M.N.J. Karunarathna[1], R.M.T.K. Ranathunga[1] and R.P.M. Sandamali[2]

Child undernutrition is still a considerable public health problem, particularly in rural communities in Sri Lanka. Few recent studies have examined the factors associated with nutritional status of children in rural communities in Sri Lanka. This study aimed to identify the nutritional status, child feeding practices and factors associated with nutritional status in rural Sri Lankan children aged 0-5 years. This study was conducted as two phases. Analysis of secondary data on socio-demographic details, nutrition and health related factors (n=639) which were collected by ChildFund Sri Lanka from six districts (Monaragala, Puttalam, Trincomalee, Batticaloa, Nuwara Eliya and Mullathivu) in 2020 was the 1st phase. A telephone survey to gather the details of feeding practices, food intake and pre-recorded anthropometric measurements from the selected families (n=73) from the same sample was the 2nd phase. Nutritional status of children was determined by WHO Anthro Plus 3.2.2 software. Dietary Diversity Score (DDS) was calculated to assess the dietary diversity of the children. Of the study sample 22%, 2.2% and 10% were underweight, severely underweight and stunted, respectively. The majority of caregivers did not introduce animal origin foods (73%), fats & oils (67%) to their children at recommended age. The mean DDS of the children was 4.6 (SD=1.5), and the majority (65.0%) fall within the medium DDS category (2.7-5.3). Gestational age ($p \leq 0.0001$), low birth weight ($p \leq 0.0001$), low DDS ($p=0.033$) and low level of caregiver's education ($p=0.016$) were significantly associated with underweight while gestational age ($p=0.004$) and low birth weight ($p \leq 0.0001$) were significantly associated with stunting. This study helps to identify the gaps in the existing knowledge among caregivers and the factors associated with child undernutrition in rural communities in Sri Lanka. It suggests to strengthen the current nutrition education programs conducted by MOH clinics emphasizing proper complementary feeding practices.

Keywords: *Child undernutrition, Dietary Diversity Score, Feeding practices.*

[1]Department of Applied Nutrition, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila 60170 NWP, Sri Lanka.
[2] ChildFund Sri Lanka, 44/3 Narahenpita, Nawala Rd, Colombo 00500.

The Impact of Covid-19 Lockdown Restrictions on Discerned Dietary and Training Habits of Sri Lankan National-Level Racquet Sports Athletes

K.H.K. Keminda[1], S. Weerasinghe[1]

The rapid spread of the COVID-19 virus created interruptions in sports activities at every level, resulting in changes in the training level and eating patterns of athletes. This study aimed to investigate whether the daily dietary patterns and training habits of Sri Lankan national-level racquet sports athletes were affected by lockdown restrictions. A cross-sectional study was carried out during and after the lockdown. Two online questionnaires were distributed among national-level badminton, tennis, table tennis, and squash athletes from 20th August 2021 to 20th September 2021 and from 11th October 2021 and 11th November 2021 respectively at the beginning and the end of the second lockdown period.

The questionnaire inquired about the demographic information, dietary habits, and training patterns of participants. The responses of 79 participants who answered both questionnaires were considered for analysis. The Chi-square test was utilized to determine the associations between the phase of lockdown (during vs. post-lockdown) and dietary and training patterns of participants at a 5% level of significance. No associations ($P>0.05$) were observed between the phase of lockdown and dietary habits such as the frequency of breakfast consumption, the number of meals consumed per day, snacking frequency, fruit and vegetable intake, and the consumption of convenience foods by participants. Statistically significant associations were observed between the following variables and the phase of the lockdown: daily water intake ($P=0.021$), the motivation to train ($P<0.001$), frequency ($P=0.013$) and duration ($P=0.003$) of cardio training, and duration of resistance training ($P=0.016$). Athletes reported that compared to the lockdown, they were more inspired to train once restrictions were lifted. Results suggest that dietary patterns such as breakfast consumption and snacking frequency, intake of fruit and veggies and convenience foods were clearly unbothered by the impact of the lockdown but an obvious deviation from the usual water intake, motivation train, frequency and duration of cardio training, and duration of resistance training could be detected during and after the lockdown restrictions.

Increased motivation to train may have inspired athletes to increase their training frequency and duration after the lockdown and more focus on water consumption may have come into the spotlight because of the increased work rate.

Keywords: Covid-19 lockdown restrictions, Dietary habits, Racquet sports athletes, Training habits

[1]Department of Sports Science, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka.

Effect of Cooking on the Oxalate Content of Three *Dioscorea* Varieties Available in Sri Lanka

W.A.E.M.P. Menike[1], J.W.A. Sajiwanie[2], and R.M.U.S.K. Rathnayaka[3]

Yams, the edible tubers of the genus *Dioscorea*, are a crop with high adaptability. With the main component of carbohydrates and significantly high protein content, they are supreme as a low-cost and nutrient-rich alternative for achieving food security in the country. Besides, the presence of anti-nutrients limits their food value, and Oxalate is one of these problematic anti-nutrients, which reduces the absorption of Calcium in the diet. Furthermore, the yams commonly consume after boiling the flesh and discarding the remaining water, where part of the oxalates is expected to leach and solubilize. However, there is limited scientific evidence on the reduction of Oxalates from the yams after cooking. Therefore, this study was conducted focusing on assessing the oxalate content in three *Dioscorea* varieties of Sri Lanka and investigating the effect of cooking on the oxalate content of those yams. Jawa ala (*Dioscorea alata*), Nattala (*Dioscorea esculenta*), and Udala (*Dioscorea bulbiferra*) were tested. The yams had cooked in boiling water at 1: 10 (W/V) for 30 minutes to analyze the cooking effect. Oxalate contents of the raw and cooked yam samples were determined using the Permanganate titration method and expressed as milligrams of anhydrous oxalic acid in 100 g of yam (fresh weight). Data were analyzed using Analysis of Variance (ANOVA) with Minitab 19 statistical software. Oxalate contents of raw Jawa ala, Nattala, and Udala were recorded as 45.0±0.00, 7.43±0.32, and 12.38±0.32 mg/100g, respectively. Cooked Jawa ala, Nattala, and Udala recorded their total oxalate content values as 28.13±0.00, 4.95±0.64, and 11.25±0.00 mg/100g, respectively. Cooking made a significant but, varietal-dependent effect on the oxalate content ($p<0.05$) by reducing the amount by 9% (Udala) to 38% (Jawa ala). Moreover, safe levels of Oxalates were observed in both raw and cooked Jawa ala, Nattala, and Udala according to the previously reported safety standards.

Keywords: *Anti-nutrients, Dioscorea, Oxalate, Sri Lanka, Yams*

Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka, Sri Lanka.
[2] Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Sri Lanka.
[3] Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Sri Lanka.

Formulation and Quality Evaluation of low Salted Garcinia Incorporated Jaadi Using Tuna Fish

K.H.S.M.S. Nishshanka[1], and M.C.N. Jayasooriya[1]

Jaadi is a fermented fish product that is produced at cottage level industry in Sri Lanka. The local traditional jaadi contains high salt concentration which has a low consumer acceptance and nutritional value. The objective of this study was to prepare jaadi using a low amount of salt and preserve its nutritional value and to increase the consumer acceptance. *Katsuwonus pelamis* (Skipjack tuna or "balaya") was selected. Other than the salt levels, fish was treated with two varieties of garcinia as *Garcinia quesita* (GQ) and *Garcinia zeylanica* (GZ). Therefore, the study was carried out using four treatments by reducing salt concentration up to 10% and 20% and two garcinia varieties (15%) and a commercial jaadi sample as a control using triplicate samples. It was revealed that GQ has the best antibacterial activity with an inhibition zone of 1.94±0.09 cm against *Salmonella* where it was 1.56±0.07 cm for GZ. The moisture, fat, protein, and ash, composition of GQ and GZ were as follows; moisture content: GQ (28.26±0.17%), GZ (30.56±0.39%); crude fat: GQ (9.27±0.26%), GZ (10.91±0.08%); protein: GQ (4.67±0.05%), GZ (4.95±0.05%); ash: GQ (5.16±0.02%), and GZ (9.44±0.04%). The highest moisture content and crude fat were in jaadi sample of GQ with 10% salt, where crude protein and ash content were high in sample with GZ with 10% salt. According to the sensory analysis data it was found that jaadi made out of 20% salt and GQ has the best overall consumer acceptability (7.97±1.13) and the crude fat, protein and ash percentages (wet basis) were 2.34±0.09, 30.92±0.12 and 14.80±0.51 respectively whereas crude fat, protein and ash percentages (wet basis) of commercial sample were 2.31±0.02, 29.15±0.14 and 38.02±0.62 respectively. Therefore *G. quaesita* with 20% salt was identified as best treatment which had enhanced sensory and quality attributes.

Keywords: *Garcinia, Jaadi, Low-slted, Skipjack tuna*

[1]Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka.

Changes in lifestyle behaviours during the economic crisis of Sri Lanka

J. Opatha[1], P. Sooriyaarachchi [1,2] , R. Jayawardena[3]

Sri Lanka is facing the worst economic crisis in its history. Millions of people are falling into poverty, jeopardizing their rights to health, education, and an adequate standard of living. This study aimed to examine how the economic crisis has affected Sri Lankans' lifestyles. An online cross-sectional survey was conducted in July 2022, using an e-questionnaire based on Google Forms. The questionnaire assessed respondents' socio-demographics and lifestyle-related behaviours before and during the economic crisis. Descriptive statistics and multivariable logistic regression analysis were used. A total of 1214 respondents, aged ≥18 years were included in this survey. Most of the respondents were using private vehicles (57.6%), as the main mode of transport before the crisis but this has shifted to public transportation (49.6%) during the crisis. Furthermore, 65.3% reported that their walking time had increased during this time, whereas 10.4% and 24.3% respectively said that their walking time had decreased or remained the same, respectively. Respondents who lived in Colombo were significantly more likely to report increased walking time compared to people from other districts (OR 1.486; 95% CI, 1.082-2.042; P=0.015). Also, those with the lowest monthly incomes (50,000 LKR) reported a twofold increase in walking time during the crisis as those with the highest monthly incomes (> 200,000 LKR) (OR= 2.077, 95%CI= 1.255-3.438, P=0.004). Cooking methods used before and after the economic crisis differ significantly, with many respondents relying on gas (pre: 92.8%; post: 15.5%) as their primary cooking fuel before the crisis and now moving to firewood (pre: 3.7%; post: 46.5%). The everyday activities of Sri Lankans have been significantly affected by the country's economic crisis.

Keywords: *cooking, economic crisis, lifestyle activities, Sri Lanka, transportation, walking*

[1] Health and Wellness Unit, Faculty of Medicine, University of Colombo, Colombo, Sri Lanka.
[2]School of Exercise & Nutrition Sciences, Faculty of Health, Queensland University of Technology Queensland, Brisbane, Australia.
[3]Department of Physiology, Faculty of Medicine, University of Colombo, Colombo, Sri Lanka.

Element Analysis of Ripened Jack Fruit (*Artocarpus heterophyllous)* Seed Flour

Y.T.Senaweera[1], R.G.P.T .Jaysooriya[2]

Artocarpus heterophyllous (L.) belongs to the family 'Moraceae' and is known as Jackfruit typically found in Southeast Asian Countries. Ripened jackfruit is commonly utilized as raw fruit which has a sweet taste. Jack fruit seed flour powder is rich with minerals such as sodium, Potassium, Calcium, Magnesium, Zinc, and Copper. The present study was aimed to quantify the minerals in ripened jackfruit seed flour for the alternative flour source rich in minerals. The cleaned matured seeds were collected from the Anuradapura area and the seed coat and brown spermoderm were removed while sampling preparation. The seeds were subjected to lye peeling using 3% sodium hydroxide for 15 minutes and washed thoroughly, cut into small pieces. The sample was dried 60 ℃ for 15 hours and ground and stored in airtight container. The triplet powder samples were analyzed using a scanning electron microscope. Ripened Jackfruit seed granules were varied with a round to uneven shapes with a mean diameter of 10.86 µm and 1.00k magnification under the scanning electron microscopic. Sodium and potassium were identified as micronutrient in jackfruit seed flour by using electron microscopic element analyzers software (Brukernano analytics). Potassium content was recorded as 0.52% ±0.136426. Sodium content was recorded as 2.21%±0.273522 (CI=0.01%).Raw jackfruit seed sodium and potassium content were recorded as 0.78%, 0.11% respectively. The ripened jackfruit seed flour also has a promising opportunity for utilizing confectionary industry which need to have more micronutrient content specially sodium.

Keywords: *Scanning electron microscope, Micronutrient, Ripened jackfruit seed Flour.*

Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.
[2] World Health Organization, Regional Office for South East Asia, New Delhi, India

Physico-Chemical and Phytochemical Evaluation of *Hulankeeriya sattva*: A Traditional Herbal Medicine and Neutraceutical in Sri Lanka

G.N. De Silva[1], J.M. Dahanayake[1*]

Correspondence: [*]Dr. J.M. Dahanayake

Hulankeeriya (*Manranta arundinacea)*, Arrowroot in English, which belongs to the Family MARANTHACEAE is a perineal plant grows with white colour rhizomes. This plant produces a starch-rich root and it is the main source which has various medicinal applications. *Sattva* is a dried extract of stems, roots or rhizomes of some plants which has high amount of starch in nature. *Hulankeeriya Satva* is a soothing demulcent and nutritive food that has traditionally been used since years. It is easily digestible, hence useful in indigestion conditions and also used as an antidote for poisons in Sri Lankan traditional medicine. *Hulankeeriya* has many therapeutic values such as indigestion, Constipation, Heart diseases, burning micturition, Painful urination, fever, cough, skin disease and burning sensation of the body. The main objective of this study was to analyze the organoleptic, physicochemical, phytochemical and pharmacognostical profiles of *Hulankeeriya Sattva* obtained from plants grown in Sri Lanka. Pharmacognostical characters and quality control parameters of ash values, extractive values, heavy metals and qualitative phytochemical analysis were performed according to WHO guidelines. Further analysis of TLC and HPTLC fingerprint patterns of methanolic extract of these plants were also conducted. The final product of *Hulankeeriya* sattva was chalky white, tasteless, odourless, and smooth in texture. Ash value, water soluble ash value, acid insoluble ash values were 1.01%, 0.4% and 15.07% respectively and moisture content recorded as 15.07%. Qualitative phytochemical analysis reveals the presence of saponins, alkaloids, tannins, phenols, flavanoids, carbohydrates and protein. Results of this physico-chemical, phytochemical, pharmacognostical and TLC analysis can be used as standard parameters and detection of any adulteration for *Manranta arundinacea.* Further *Hulankeeriya Sattva* can be introducing as a quality assured nutraceutical which will be benefit in the primary healthcare system of Sri Lanka.

Keywords: *Hulankeeriya, Nutraceuticals, Sattva, Standardization*

Dietary diversity among mothers and children aged 6-23 months in estate communities in Nuwara-Eliya district

S. Sugirtha[1], A.M.N.T. Adikari[1], D. Peiris[2] and B. Suthan[2]

Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods. Despite attempts to diversify the diet, considerably larger proportion of estate people rely on monotonous diets, suggesting influence of several factors determining dietary diversity. Hence, this study was conducted to assess the dietary diversity and identify its determinants among mothers and their children aged 6-23 months in estate communities in Ambagamuwa in Nuwara-Eliya district. A total of 123 mother and child pairs were selected using a multi-stage simple random sampling technique for this cross-sectional study. Information on socio-demographic characteristics, food purchasing behaviors, dietary habits and believes, and child feeding practices were obtained through interviewer administrated questionnaire. The single 24-hour dietary recall was used to determine individual dietary intakes and minimum dietary diversity. Both bivariate and multivariate logistic regression analysis were used to identify the determinants of dietary diversity. A 10 food group's scale and 7 food group's scale were used to determine dietary diversity score for mothers and children respectively. The mean dietary diversity score of studied mothers and children were 5.1 ±1.2 and 3.9 ±1.3. Overall, 68% of mothers and 60% of children achieved minimum dietary diversity score, respectively. Results revealed that monthly income (AOR= 5.75), mother's educational level (AOR=3.17), mother's occupation (AOR=7.48), engaging livestock farming (AOR=1.48), and meal skipping (AOR=1) were the determinants of dietary diversity among mothers while monthly income (AOR=1.65), mother's educational level (AOR=2.42), age of child (AOR=2.46), engaging the home gardening (AOR=1.62), meal frequency (AOR=3.36), and following the instruction on child feeding practices from Maternal and Child Health clinics (AOR=1.25) were the determinants of child's dietary diversity. This study emphasizes the need of incorporating identified determinants of dietary diversity among mothers and children for the major nutrition intervention programs to improve the nutritional status of the study area.

Keywords: *Child feeding practices, Dietary diversity, Estate communities*

[1]Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka.
[2]World Vision Lanka, Colombo, Sri Lanka.

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The panel of judges

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- Prof. Niranjalie Perera, Department of Food Science and Technology, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka
- Dr. Geeshani Somaratne, Senior Lecturer, Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya


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