



THE NUTRITION SOCIETY
OF SRI LANKA



PROCEEDINGS

ANNUAL SCIENTIFIC SESSIONS
OF THE NUTRITION SOCIETY OF SRI LANKA
2022

Proceedings

of the

Annual Scientific Sessions

of

The Nutrition Society of Sri Lanka

'Nutrition, health and wellbeing in a challenging era: Moving forward with 50 years of experience'

22nd – 23rd January 2022

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<p align="center">Annual Scientific Sessions of The Nutrition Society of Sri Lanka 22nd - 23rd January 2022 Virtual Conference “Nutrition, health and wellbeing in a challenging era: Moving forward with 50 years of experience” DAY 1 : Saturday 22nd January 2022</p>	
Time (Sri Lankan)	Event
8.30 a.m.	Lighting of oil lamp & National anthem
8.35 a.m.	Welcome Speech Prof. Chandima Wickramatilake, the President, NSSL
8.45 a.m.	Address by the Chief Guest “Addressing nutrition challenges through food system transformation” Dr. Francesco Branca, the Director, Department of Nutrition for Health and Development, World Health Organization, Geneva
9.00 a.m.	Keynote Address “Recollections on nutrition in a professional career as a clinical teacher in Paediatrics” Prof. Narada Warnasuriya(<i>Past President- NSSL</i>) Senior Professor of Paediatrics, Department of Paediatrics, Faculty of Medicine General Sir John Kotelawala Defense University, Sri Lanka
9.30 a.m.	Presidential Address “Have we paid adequate attention to the trends in the nutritional health of adolescents?” Prof. Chandima Wickramatilake, the President, NSSL
9.50 a.m.	Launching programmes celebrating the Golden Jubilee
10.05 a.m.	Vote of Thanks Mrs. R. P. M. Sandamali, Joint Secretary, NSSL
10.10 a.m.	Comfort Break
10.30 a.m.	Symposium 1 Aging, Chronic Diseases & Nutrition Symposium Chair: <i>Dr. Renuka Jayatissa (Past President- NSSL), Medical Research Institute, Sri Lanka</i>
	Plenary Lecture Ageing & Non-communicable Diseases Prof. S. A. M. Kularatne, Department of Medicine, Faculty of Medicine, University of Peradeniya, Sri Lanka
	Symposium Lecture Dietary Habits & Non-communicable Diseases Prof. Ranil Jayawardena, Department of Physiology, Faculty of Medicine, University of Colombo, Sri Lanka
	Symposium Lecture The bidirectional link between Metabolic Syndrome and Mental Health Prof. Shehan Williams, Department of Psychiatry, Faculty of Medicine, University of Kelaniya, Sri Lanka
	Panel Discussion

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11.45 a. m.	Symposium 2 Communicable Diseases, Health & Nutrition <i>Symposium Chair: Dr. Shanthi Gunawardnan(Past President- NSSL), Consultant Community Physician, Ministry of Health, Sri Lanka</i>
	Plenary Lecture Novel epidemiological approaches in the management of communicable disease Prof. Samath Dharmaratne, Department of Community Medicine Faculty of Medicine, University of Peradeniya, Sri Lanka
	Symposium Lecture Critical care management of nutrition in Infectious disease Mrs. Priyanwada Amarasekara, Swansea Bay University Health Board Neath Port Talbot hospital, the United Kingdom
	Symposium Lecture Infectious disease, Immunity & Indigenous dietary approach Dr. Senaka Pilapitiya, Department of Medicine, Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka, Sri Lanka
	Panel Discussion
1.00 p.m.	LUNCH BREAK
1.30 p.m	Flash Talks on Free Communications Session Chairs: <i>Prof. Terrence Madhujith (Conference Editor) , Ms. Thamlini Joshepkumar (Conference Coordinator)</i>
3.00 p. m	Oral Presentations on Free Communications Session Chairs: <i>Dr. Ananda Chandrasekara, Joint Secretary, NSSL, Ms Malika Gayathri Fernando, Council Members, NSSL</i>
5.00 p.m.	End of the Day
DAY 2 : Sunday 23rd January 2022	
Time	Event
8.30 a.m.	Symposium 3 Food Security & Nutritional Wellbeing Symposium Chair: <i>Prof. Anoma Chandrasekera (Past President- NSSL), Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka</i>
	Plenary Lecture Food Security and Nutritional Wellbeing in Sri Lanka: Implications for Food Price Policies Prof. Jeevika Weerahewa, Department of Agricultural Economics and Business Management, Faculty of Agriculture, University of Peradeniya, Sri Lanka
	Symposium Lecture Policy Changes are negatively affecting Food Security of Sri Lankans Prof. Buddhi Marambe, Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka
	Panel Discussion
9.30 a.m.	Prof. T.W. Wikramanayake Oration “Poor dietary diversity and nutritional inadequacy: unveiling the nutrition paradox in Sri Lanka” Prof. Renuka Silva(<i>Past President- NSSL</i>), Professor of Nutrition, Department of Applied Nutrition, Wayamba University of Sri Lanka, Sri Lanka

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10.15 a.m.	Cultural Event & Comfort Break
10.30 a.m	Oral Presentations on Free Communications Session Chairs: <i>Prof. Terrence Madhujith & Ms Malika Gayathri Fernando Council Members, NSSL</i>
12.30 p.m.	LUNCH BREAK
1.00 p.m.	Symposium 4 Safe Food for Healthy Future Symposium Chair: <i>Dr. Jaanaki Goonaratne (Past President- NSSL), Former Head/Senior Deputy Director, Food Technology Section, Industrial Technology Institute, Colombo, Sri Lanka</i>
	Plenary Lecture Food Safety in the Era of COVID -19 Pandemic Dr. Senaka Ranadheera, Senior Lecturer (Food Processing and Preservation) School of Agriculture and Food, University of Melbourne, Australia
	Symposium Lectures Technology & Food Safety: Facts & Myths of Genetically Modified Food & Organic Food Dr. Laura Privalle, Global Head, Product Safety Assessment, BASF Dr Nenad Naumovski, Associate Professor in Food Science and Human Nutrition, School of Rehabilitation and Exercise Sciences, Faculty of Health, University of Canberra, Australia
	Symposium Lecture National Food Control System: Foo Safety & Quality Assurance in Sri Lanka Emeritus Prof. Upali Samarajeewa, Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka
	Panel Discussion
2.15pm	Flash Talks on Free Communications <i>Dr. Ananda Chandrasekara, Joint Secretary, NSSL, Ms. Thamlini Joshepkumar (Conference Coordinator)</i>
	Comfort Break
3.45 p.m.	Awards & Appreciations
4.00 p.m.	Closing Remarks by Conference Chair <i>Dr. Dhammika Senanayake</i>
4.05 pm	Closing Remarks by Conference Editor <i>Prof. Terrence Madhujith</i>
4.10 p.m.	Annual General Meeting the Council
	Introduction of New President & Council
5.30 p.m.	End of the Day

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Message from the Chief Guest

“Addressing nutrition challenges through food system transformation”



Multiple forms of malnutrition affect the world and they are often present simultaneously. Wasting and stunting are still affecting 39 million children and 149 million children under 5, while overweight affects 39 million children. Over 600 million adults are obese and 264 million women in reproductive age area affected by anemia. Progress towards the achievement of the 2025 global nutrition targets is slow. The COVID-19 pandemic has reversed some of the progress made. It is estimated that an additional 5 to 7 million children may be stunted, and 570 thousand to 2.8 million more may be wasted in 2030 as a result of the food insecurity and the disruption of health services. In addition, about 10 million deaths every year are due to the consumption of unhealthy diets. Unhealth and malnutrition are top risk factors for the Global Burden of Disease.

A profound food system transformation is needed to provide safe and healthy food for all. Food systems can make us sick or help us keep healthy also through zoonotic pathogens and antimicrobial resistance, unsafe and adulterated foods, environmental contamination and occupational hazards.

Public health policies can play a critical role. WHO has developed a “menu for action” to make diets healthier and safer that includes (a) measures to nudge food companies to eliminate trans fats and to reduce sugars and salt (this has been done in 60 countries); (b) fiscal policies (the taxation of sugar-sweetened beverages is implemented in 79 countries); (c) provision of healthy meals in public institutions (implemented in 80 countries); (d) nutrition labelling (Front-of-the-Pack labelling is implemented in 41 countries); (e) food fortification (wheat flour fortification is implemented in 87 countries) and (f) restrictions of marketing of food and non-alcoholic beverages to children (currently implemented in 50 countries).

The 2021 UN Food Systems Summit will provide an opportunity for change and scale up of these solutions. 163 Member States participated actively and 108 countries submitted National Pathways for action. Thirty Multi-Stakeholder Initiatives and Coalitions of Action were established and, among them, a coalition for Action on Healthy Diets from Sustainable Food Systems for Children and All. The scope of this Coalition is deliberately wide and affords multiple entry points to diverse food systems actors. It encourages a diversity of action, relevant to the local context. A group of 13 frontrunner countries (Brazil, Chile, Denmark, Ecuador, Ethiopia, Finland, Ghana, Nigeria, Norway, Slovenia, Sweden, Switzerland and UAE), together with 5 UN agencies (WHO, UNICEF, FAO, UNEP, and WFP), supported by SUN and UN Nutrition are taking the lead and will be supported by several NGOs and Academic and Research Partners. The 3 main action areas will be: the food supply; food environments and consumers’ appreciation of food. The Coalition will build on national dialogues and country plans and contribute to connecting and implementing them. The UN will host a Coordination Hub that will organize global stocktaking every 2 years through 2030.

Dr. Francesco Branca,
The Director, Department of Nutrition for Health and Development, World Health Organization,
Geneva

Message from the President, NSSL



I am very much honoured and privileged to inform you that the council of The Nutrition Society of Sri Lanka (NSSL) 2020-2021 has been able to organize the Annual Scientific Sessions- 2022 as a hybrid event among the uncertainties and with the 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 marks 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 started organizing events to celebrate the 50th anniversary of the NSSL since 2021. The Golden Jubilee which falls in 2022 is a landmark event of the history of the society and will be celebrated in grand scale, adhering to new normal amidst COVID-19 pandemic. Organizing Mobile Photography Challenge for Youth, NutriEssay competition, and NutriCa Arts competition for school children and printing a desk calendar are among the activities already completed in 2021 in celebrating the 50th anniversary. Along with the golden jubilee, the council has organized launching of an official journal for the NSSL- The Journal of Nutrition and Food Sciences and a webpage for digital repository of nutrition related local research publications and a fund raising programme to establish a permanent office for the NSSL. A short documentary video about the progress and the activities of the NSSL will also be released.

I have great pleasure in welcoming all of you to the inauguration ceremony and the technical sessions of the Annual Scientific Sessions 2022 of the NSSL, when we mark the 50th anniversary. We have many dignitaries with us joining online and in person. I am deeply honored to welcome our chief guest, Dr. Francesco Branca, The Director of Department of Nutrition for Health and Development, World Health Organization, Geneva. Despite his busy schedules, he has kindly accepted our invitation to enrich this event with his vast experience on global situation on nutrition.

The council 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 in the past. A warm welcome to all the honourable past presidents, who are here with us. I would like to extend a warm welcome to the keynote speaker, Prof. Narada Warnasuriya, Senior Professor of Paediatrics Department of Paediatrics, Faculty of Medicine, General Sir John Kotelawala Defense University. He is one of our oldest members and was a past president as well. It is very inspiring to have a giant in the field of clinical training and a dedicated long-term life member of NSSL as the keynote speaker. I sincerely welcome Prof. Renuka Silva, Professor of Nutrition, Department of Applied Nutrition, Wayamba University of Sri Lanka, the orator of Prof. T.W. Wikramanayake Oration 2022. He is one of the past presidents who has actively

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contributed to the activities of NSSL. I would like to extend my warm welcome to all the symposium chairpersons as well.

The theme of this year's sessions is "Nutrition, health, and wellbeing in a challenging era: Moving forward with 50 years of experience". With the COVID-19 pandemic and its aftermath, the world is facing problems in many fields including nutrition and health. The effects will be more on low-and middle- income countries. Because the triple burden of malnutrition which is already experienced by these countries will be aggravated as a result of the disruption caused by the pandemic. We hope that our audience will find the symposium/ plenary lectures are timely and useful. I warmly welcome all the distinguished guests, invitees, speakers, judges, presenters, life members, and the participants joining with us online and in person.

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 2021 amidst of financial constraints.

The NSSL Annual Scientific Sessions is one of the most enriched forums for sharing knowledge, reviewing and showcasing the scientific output in the field of nutrition. I convey my best wishes for the Annual Scientific Sessions 2022 of the NSSL.

Prof. Chandima Madhu Wickramatilake
President, NSSL

Message from the Joint Secretary, NSSL



As the joint secretary of The Nutrition Society of Sri Lanka, let me have the pleasure of extending my deep appreciation for the support and encouragement provided by each and every one of you. Conducting this time NSSL Annual Scientific Session had been such a challenge amidst an everlasting pandemic that hit all aspects of our lives.

Let me start off by extending our heartfelt gratitude to our Chief Guest, Dr. Francesco Branca, The Director, Department of Nutrition for Health and Development, WHO, Geneva, who honored this function with his inspirational thoughts.

I would also like to thank the keynote speaker, Dr. Narada Warnasuriya from Department of Pediatrics, Faculty of Medicine, General Sir John Kotelawala Defense University, who is also a life member and a past president of the society. Dear Sir, your valuable insights helped us ignite the momentum and highlighted our role during this unprecedented time as a professional network.

The main purpose of the Scientific Session was to present novel scientific findings and research outcomes and exchange views on the matters under consideration. The organization of such sessions is generally a result of close cooperation among several institutions and individuals. 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 the scientific session happened wonderfully this time as well.

My special thanks are also due to Dr. Lal Ekanayake, the Director of the Institute of Sports Medicine, and the supportive staff members for providing us with this wonderful venue and giving us all the technical and logistic support to make this event successful. Handling a hybrid event, although common these days is such a challenging effort and an added workload for all who collaborate. Thank you so much for your corporation in all matters that affect in this kind of a virtual event.

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, who are the reason of this event. This is a unique opportunity to learn from the world's best experts in Nutrition and Health. I attest that you wouldn't regret the time.

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Last but not least, I must mention the support provided by the council members of the NSSL, including the President. I must say that their contribution has been invaluable and indispensable for our efforts during this difficult time. 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!

Thank you all.

R P M Sandamali
Joint Secretary, NSSL

Message from the Conference Chair, Annual Scientific Sessions - 2022



As the chair of the Annual scientific sessions of the Nutrition Society of Sri Lanka (NSSL), I am delighted and honored to bring this message. This year has been significant for the nutrition society as we celebrate the 50th anniversary of the society. Nutrition Society of Sri Lanka links Nutritionists, Medical professionals, Scientists and all interested parties of the field of Nutrition together. The Annual scientific sessions of the Nutrition Society of Sri Lanka is the main scientific forum that provides an ideal platform for the Sri Lankan professionals and researchers to discuss and debate on nutrition-related research findings and the latest advancement of nutrition science. The council of the NSSL was determined to hold the sessions on a virtual platform amidst the obstacles faced during the pandemic. I hope that these sessions will allow the participants a productive discourse not only is aspiring excellence in nutrition science but also about how it relates to human health. Some of the underlying issues in nutrition will be covered in depth during the Annual Scientific Sessions 2022, by our Keynote and guest speakers.

The success of the scientific sessions 2022 depends on the dedication and the hard work of many people. I am amazed by the dedication of the President of the society Prof. Chandima Wickramatilake and all the council members. I wish to express my sincere gratitude to the Chief guest Dr. Francesso Branca-Director, Department of Nutrition for Health and Development, World Health Organization, Keynote lecturer prof. Narada Warnasuriya, all speakers, judges, abstract reviewers and young researchers who shared their abstract with the sessions. Special thanks go to Prof Renuka Silva speaker of the prof. T.W. Wickramanayake memorial oration. I am grateful to Dr. Lal Ekanayake and the staff of the institute of sports medicine for their great support for the Annual scientific sessions. Mr. Kapila Bandara and his team made our session successful with a virtual platform. Finally, I would like to thank our sponsors for their generous financial support

Dr Dhammika Senanayake

Conference Chair - Annual Scientific Sessions of the NSSL- 2022

Message from the Conference Editor, Annual Scientific Sessions - 2022



It is my privilege and pleasure to write this message at the time The Nutrition Society of Sri Lanka celebrates its fifty year of existence in the country. The president and the council has been very thoughtful in organizing the annual sessions in a grand manner in order to mark the fiftieth anniversary of the society in January 2022. The Nutrition Society of Sri Lanka is the only society in the country that has been established by a parliament act and working toward a common goal of ensuring proper nutrition for all. Established half a century ago by a group of medical professionals subsequently broadened its horizons by opening up membership for all who show an interest in nutrition.

Despite the enormous difficulties and challenges faced by the organizers imposed by the global pandemic, the organizing committee has been extremely successful to compile fifty abstracts of full-length presentations, flash presentations and invited speeches. In a way, the receipt of communications is indicative of the volume of nutrition-related research going on in the country.

The abstracts received were rigorously reviewed for their scientific merit with the assistance of scholars in the fields of nutrition and food science before they were accepted. Flash presentations were introduced this time in place of poster presentations. The Annual Sessions are enriched with four symposia, fourteen invited and plenary speeches, twenty one full length presentations and twenty nine flash presentations. Experts from all corners of the world contribute to the sessions as speakers, paper presenters and evaluators.

A surge in research in the fields of nutrition and food sciences was observed in the country. A dozen of state and private universities, research institutions and other entities have immensely contributed to the research output, however, there has not been a dedicated journal in either nutrition or food science for the researchers to publish their work. The present council headed by Prof. Wickramatilake decided to fill this gap by initiating the journal titled 'The Journal of Nutrition and Food Sciences' at the time the society celebrates the fiftieth anniversary.

As the Conference editor, I wish to express my sincere gratitude for the chief guest, keynote speaker, other invited speakers, Professor T.W. Wickramanayake orator, paper presenters reviewers and symposium chairs and panels of judges and all others who contributed toward the success of the event.

Prof Terrence Madhujith
Conference Editor - Annual Scientific Sessions of the NSSL- 2022

Keynote Address

Recollections on nutrition in a professional career as a clinical teacher in Paediatrics



Prof Narada Warnasuriya (Past Preseident-NSSL)

Department of Paediatrics, Faculty of Medicine, General Sir John Kotelawala Defense University

As a senior member of the Nutrition Society of Sri Lanka (NSSL) I am honoured to deliver the keynote address at its golden jubilee anniversary sessions in 2022 on the theme "Nutrition, Health and Wellbeing in a changing era; moving forward with 50 years of experience."

At the outset, I must acknowledge my guru and mentor Professor Priyani Soysa, the only surviving founder member of the Society who should rightfully have delivered this address. Though she is still mentally competent and alert, physically she is unable to be here to do so.

Instead of speaking on a specific area pertaining to the theme, as customary in a keynote address, I thought it more appropriate on this occasion to recollect and reflect on some aspects of my professional career of fifty years as a clinical teacher in Paediatrics, and 48 years as a member of the NSSL, which impacted directly on the nutritional wellbeing of our nation.

I will limit my recollections to four specific areas; management of children with severe acute energy protein and other related nutritional deficiencies in the seventies at the Lady Ridgeway Hospital; my involvement as a Paediatrician in developing and implementing policies related to infant and young child feeding; my role as the principal trainer in the late 1990s in a nationwide community empowerment programme the Participatory Nutrition Improvement Programme (PNIP); my role in planning and delivering the M.Sc. in Human Nutrition, a post graduate programme for medical graduates at the Postgraduate Institute of Medicine (PGIM), Colombo.

Due to complex social, cultural, political and economic factors there was an increase in severe acute energy protein malnutrition and other related nutritional deficiencies in the 1970s, resulting in admission of children with clinical syndromes of marasmus, marasmic kwashiorkor and kwashiorkor to Lady Ridgeway Hospital, Colombo. Initially as a registrar in paediatrics and subsequently as a consultant on the malnutrition ward of the university Paediatric unit I was intimately involved in the acute management and subsequent rehabilitation of these children at the Talagolle convalescent home. I will critically reflect on the management modalities used initially and how they evolved with the guidance of the WHO expert committee on management of acute severe energy protein malnutrition. I will also refer briefly to the recent developments of managing these children in the immediate post-civil war period using ready to use therapeutic food.

“Keeping a well-child well” was considered as or more important as “making a sick child well” in the view of Prof CC De Silva, the founder Professor of Paediatrics at the University of Ceylon and the founder president of the NSSL. Paediatricians play an important role in health promotion. Infant and

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child feeding is their core concern. Following on the example of Prof Priyani Soysa, I was actively involved in policy making, implementation, and training of other health professionals in infant and young child feeding.

I will describe my role in developing IYCF guidelines, adopting and monitoring the code for marketing breast milk substitutes, developing guidelines for initiation of breast feeding and BFHI, WHO expert consultation on optimal duration of exclusive breast feeding, preparing guidelines for infant feeding during disasters and latterly on developing policies in respect of managing conflict of interest in dealing with the food industry.

Participatory Nutrition Improvement Project (PNIP) was a community based nutrition improvement programme implemented nationwide by the government, with UNICEF sponsorship. It was a community empowerment and social mobilization programme implemented through newly recruited graduate trainees and community volunteers. They were expected to develop a community-specific nutrition action plan using a participatory approach.

I was the principal trainer for the project leading a multi-disciplinary team of academics and officers from the Ministry of Plan Implementation. I will critically reflect on our experience, highlighting both strengths and weaknesses.

Finally, I will describe and reflect on my role in planning and implementing a postgraduate course, M.Sc. in Human Nutrition for medical graduates in the PGIM. The course was developed at the behest of the Ministry of Health which was keen to develop a pool of medical officers with specialized knowledge in human nutrition who could work in both clinical and community settings. A committee of clinical and public health professionals who had a track record of teaching, training and research in human nutrition was appointed to plan and develop the course. I was honored to be elected the Chairman of the Committee. After a series of formal and informal stakeholder consultations and wide perusal of the curricula of Masters level courses in Nutrition, both local and global, we planned a M.Sc. programme with a unique format which involved using a series of reflective portfolios as the main method of assessment instead of the customary research dissertation. The rationale of this approach and its impact on achieving the intended learning outcomes, will be critically reflected upon. The service role of these graduates within the health services and subsequent developments in this training will be briefly addressed.

Although I will not be referring to my role within the Nutrition society as a member, honorary secretary, council member and president in this address, there is one activity which I take great pride in, which I shall refer to. Although this society was founded by a dedicated team of professionals almost exclusively from the health sector, it was their intention that it become a truly multi-disciplinary forum representing all professionals whose work impacted on nutritional wellbeing. Unfortunately during the first six years of its existence this did not materialize and most professionals from non-medical sectors preferred to use other forums like the SLAAS to present. It was in 1978, during Prof Priyani Soysa's tenure as president that the council took a decision to actively seek and recruit members from other disciplines whose work impacted on nutrition. It was left to myself and the co-secretary Dr. Dulitha Fernando to actually implement this decision. We did it diligently and recruited many new members from varied disciplines such as agriculture, food technology, economics, education and science. Some were co-opted to the Council directly and went on to be active members of the council including the presidency. The scientific sessions of the Nutrition Society became truly multi-disciplinary in nature. It has come long way since then and could now be considered a bench mark for a multi-disciplinary professional society.

Presidential Address

Have we paid adequate attention to the trends in the nutritional health of adolescents?



Prof. Chandima Madhu Wickramatilake

President, NSSL

Introduction

Adolescents are a group of paediatric population for whom a due concern and recognition is not given when nutrition and health concerned, especially in Asian countries including Sri Lanka. Adolescents are a dynamic group (aged 10-19 years according to WHO) experiencing their pubertal growth spurt and are in a vulnerable period of time for nutritional deficiencies. Moreover there is lack of research examining their nutritional behavior which is of immense importance for healthy working force.

With the epidemiological transition that happens during the past few decades in most of the Asian countries there is change in their life styles especially dietary behavior and physical activities. It has been revealed an upward trend of sedentary time among Chinese children aged 6-17 years from 2004 to 2015 (Yang, Leung, Chen, Ouyang, & Zhao, 2021).

The overall prevalence of stunting in South Asian adolescents was 13%, thinness was 10.8% and overweight was 10.8% of the 24,053 South Asian school adolescents aged 12-15 years that participated in the cross-sectional Global School-Based Student Health Survey (GSHS) between 2009 and 2016 (Estecha Querol, Iqbal, Kudrna, Al-Khudairy, & Gill, 2021). This indicates the presence of double burden of malnutrition and the associated potential micronutrient deficiency (hidden hunger).

Nutrition & related health problems in adolescents

Nutrition associated non-communicable diseases in childhood and adolescence, is one of the serious public health problems worldwide. According to the World Health Organization, 10% of young people aged 5-17 years are obese, which is rapidly increasing around the world. Furthermore, approximately 80% of adolescents who become obese develop body weight-related health problems in adulthood (WHO, 2021).

Obesity and metabolic syndrome (MetS) are increasing health issues among adolescents in Asia. In the Korean National Health and Nutrition Examination Survey, 2007 to 2018 done on 6,308 adolescents aged 12 to 18 years showed stable rate of the prevalence of MetS, but the prevalence of central obesity and hyperglycemia has increased greatly in the recent decade (Chae, Seo, Kim, & Park, 2021). Global School-Based Student Health Survey (GSHS) between 2009 and 2016 revealed the overweight of 10.8% (Estecha Querol et al., 2021). It has shown that prevalence of fasting hyperglycemia among children and adolescents has increased over the past decade, and this increase is potentially associated with other related non-communicable diseases among Korean adolescent aged 10-18 years (Yoo et al., 2021).

Micronutrient deficiencies in adolescents

In both over-nutrition (overweight/obesity) and under-nutrition coexisting micronutrient deficiencies is a potential problem. An Indian study done on children and adolescents (10-19 years old) had shown 31% prevalence of Zinc deficiency defined by the cut-offs of International Zinc Nutrition Consultative Group was (Pullakhandam et al., 2021). Comprehensive National Nutrition Survey done in India during 2016-2018 has exhibited high prevalence of iron deficiency anaemia(30.4%) in adolescent girls with lower prevalence in adolescent boys (Kulkarni et al., 2021).

Data from the Malaysian Health and Adolescents Longitudinal Research Team study indicated overall increasing trend of anaemia among adolescents and high prevalence of anaemia among female adolescents (Krishnan, Zaki, Nahar, Jalaludin, & Majid, 2021).

Prevalence of vitamin D deficiency is considerably high among children and adolescents in India and higher among female adolescents (76.16%) (Mustafa & Shekhar, 2021). Prevalence of vitamin A deficiency was 14.4% in a group of Indian adolescents (Reddy et al., 2021).

Dietary behavior and nutritional health of adolescents

The proper nutritional health in adolescents goes back to the nutritional behavior of early childhood. An Iranian national survey conducted among 4200 participants, aged 7-18 years showed the association between using human milk and home-made food as complementary feeding with better lipid profile in childhood and early adolescence (Vard et al., 2020). This indicates the basis of early childhood nutrition for a healthy adolescence.

Korea National Health and Nutrition Examination Survey, 2007 to 2018 demonstrated that total calorie intake and calorie intake from fat has increased significantly while calorie intake from carbohydrates has decreased significantly in adolescents(Chae et al., 2021). A survey revealed poor dietary behavior among Indonesian adolescents and many of them skipped breakfast (Indriasari, Nadjamuddin, Arsyad, & Iswarawanti, 2021). Poor dietary diversity is identified among adolescents currently. An Indian study revealed low dietary diversity among 24% of adolescent girls and project interventions of participatory group meetings improved mean dietary diversity scores (Unisa et al., 2021). Changing the unhealthy dietary behavior is not feasible in spite of the presence of adequate knowledge and the positive attitudes. In a study done on Malaysian adolescents it has been revealed that 88.4% had a good attitude, 51.8% a moderate knowledge, but 40.5% had poor practice. Moreover, they found that those with a higher body fat percentage showed significantly good attitude scores (Teng, Juliana, Izlin, & Semaon, 2020).

Lifestyle factors and nutritional health of adolescents

Adolescence is a vulnerable period where there is easy tendency to develop either favorable or unfavorable lifestyle changes. The proportions of tobacco smokers and regular walkers significantly decreased from 2007 to 2018 according to Korea National Health and Nutrition Examination Survey (Chae et al., 2021). Sedentary time among Chinese children aged 6-17 years showed an upward trend from 2004 to 2015, especially among those residing in rural areas and regions with low urbanization levels (Yang et al., 2021). Among 5809 Bhutanese adolescents, aged 13 to 17 years exhibited considerable prevalence of poor dietary behavior and tobacco and alcohol use (Choeda et al., 2021).

Sedentary life style, physical inactivity and high screen time are common among 510 students aged 12-16 years in Iran and suggest the possibility of increase in the trend with the COVID-19 (Hadianfard, Mozaffari-Khosravi, Karandish, & Azhdari, 2021). The Asia –fit study which included adolescents from selected Asian countries showed the association between the compliance for 24-hour movement guidelines and body fat percentage (Hui et al., 2021). A Korean study demonstrated that milk intake and physical activity have a combined effect on bone mineral density and health of bone in adolescents. Therefore moderate to vigorous physical activity and milk intake during adolescence are important to achieve a good bone health (Lee, Ha, Kim, & Kim, 2021). Presence of outdoor advertisement on unhealthy food and beverages are believed to be associated with increased tendency of consuming those by the adolescents and prone to get non-communicable diseases (diabetes, obesity and cardiovascular diseases) in future (Puspikawati et al., 2021).

A prospective cohort study (2012-2016) consisted of 436 Malaysian adolescents with a baseline age of 13 years showed that higher protein and carbohydrate intake was associated with higher muscle strength in males but not in females. Therefore, they recommend that tailor-made nutrition and physical activity focusing on strength building are required in early adolescence for males and females separately (Ng et al., 2020). A cohort study conducted among adolescents in Singapore, aged 10-16 years, who were overweight and obese has revealed that introduction and engagement with a mobile app-based lifestyle intervention program before the enrollment in a clinic-based multidisciplinary weight management program is a feasible strategy of obesity management service especially for a low-income and a racially diverse population. Participants showed statistically significant improvements in measured body fat percentage, self-reported quality of life, and self-reported caloric intake at 3 and 6 months (Chew et al., 2021). A trial conducted using culturally acceptable dance/fitness intervention on Asian Indian adolescent girls showed the potential to be a sustainable intervention to improve cardiorespiratory fitness and to prevent NCDs (Anjana et al., 2021).

Sri Lankan context

According to research findings published in 2006, problems associated with the nutrition related behavior among Sri Lankan adolescents were missing the breakfast, eating less fruits & vegetables, poor physical activities and high screen time. They have suggested educational and interventional programme at school level (Jayatissa & Ranbanda, 2006). According to another study published during the same period showed the existence of multiple micronutrient deficiencies (folate, Zinc and iron) among the adolescents of the age of 12-16 years in Galle (Hettiarachchi, Liyanage, Wickremasinghe, Hilmers, & Abrahams, 2006). There was significant prevalence of undernutrition among female adolescents (39.1%) living in estates in Sri Lanka and it was associated with the low socioeconomic strata, low dietary diversity, food purchase at each meal/daily and poor food availability. The authors recommended to conduct targeted nutritional intervention programmes to improve their dietary behavior along with addressing the poverty and the food availability (Niranjala & . Gunawardena, 2011). Among a group of adolescents in of Kandy district of Sri Lanka, thinness (<5th percentile according to WHO cut-offs) was reported as 49% and prevalence of overweight was 2.1 %. Their nutritional status was significantly associated with maternal education level and the number of siblings in the family (Kumburegama & Sharmila, 2015). In study done among adolescent in Kalutara district also had demonstrated similar finding showing the existence of double burden of malnutrition among adolescents (Weliange & Fonseka, 2006). A recent study conducted in 2019 among the adolescents of the age 12-14 in Ratnapura district of Sri Lanka showed that most of them frequently or sometimes consume junk food as their breakfast except 33.3 %. Out of them 72% of the students were aware of the unhealthiness of the junk food habit and more than 85% of the parents were aware and students were knowledgeable about the nutrient facts, 72.7% consumed it due to the taste and due to its convenience. They found that the junk food consumers are more obese than non-junk food consumers (Ekanayake & Wijesinghe, 2021). A study on dietary habits based on the Diet Quality Index–International (DQI-I) among Sri Lankan rural adolescents showed that DQI-I is positively associated with micronutrient consumption and negatively associated with the percentage of total energy coming from carbohydrates (Williams et al., 2019).

School health promotion programme, school medical inspection, establishment of adolescent clinics, introduction of school canteen policy and national strategic communication plan for nutrition are some of the many initiative obtained by the Ministry of Health Sri Lanka in collaboration with Ministry of Education. However, level of effective implementation and the quality of operation of certain programmes are uncertain with the limited physical and human resources at the local setting.

Considerations to plan for a better nutritional health among adolescents in future

A school-based Malaysian study has identified the barriers perceived by the adolescent to adhere to the healthy dietary behavior. Limited availability of healthy options, unhealthy food preferences and affordability were important challenges preventing healthy eating at school. Low-quality physical education classes and limited teachers' commitment during lessons were perceived as barriers to adolescents being active at school (Mohammadi et al., 2021). These barriers could be common to any

other Asian country and need to be addressed in health promotion campaigns. Identification of barriers and the motivators for the lifestyle modification is important to minimize the drop outs from the programmes. Lower family functioning, non-self-referral and initial low attendance are associated with higher dropouts from the programmes (Park et al., 2020).

Public participatory education on proper dietary intake and lifestyle modification is required for a successful implementation of an educational programme (Chae et al., 2021; Unisa et al., 2021). An Indonesian study revealed that innovative nutrition education intervention improved breakfast frequency and nutrient intake among adolescents with long-term sustainability (Indriasari et al., 2021). A qualitative study among Iranian adolescents showed that motivational systems are useful in the maintenance of the safe and healthy nutrition (Kaveh, Moradi, Morowatisharifabad, Najarzadeh, & Fallahzadeh, 2021). Therefore educational programmes in combination with motivational programmes are important in changing the dietary behaviour in adolescents (Kaveh et al., 2021). Moreover, there is gender differences in the dietary behavior. Therefore tailoring of dietary interventions are necessary to make a sustainable behavior change (Otsuka et al., 2020). Among the many, the body image is one of the main determinants of dietary behavior and physical activities of adolescents. Hence, addressing body image concerns would affect the efficiency of the intervention programmes (Niswah, Rah, & Roshita, 2021).

In the promotion of healthy nutritional behavior we can use various modes in future. An Indonesian study had displayed that online nutrition campaign was well accepted by Indonesian urban adolescent females. Campaign had motivated them to act to protect their health (Januraga et al., 2021). A review article has emphasized that in the management and the prevention of the nutritional problems in adolescents, merely the nutritional education and the nutritional intervention might not help unless there is improvement of the environment and the socioeconomic background (van Tuijl, Madjidian, Bras, & Chalise, 2021).

It advisable to establish community level nutrition clinics and to expand of adolescent clinics with adequate human resources and infra-structure development in the local setting. Further, expansion of the school meal programme to school going adolescents and provision of micronutrient fortified food to vulnerable adolescents are other possible strategies that can be used in the prevention of adolescent nutritional problems. Proper implementation and monitoring of the operation of the school canteen policy is an important approach. Novel public-private partnerships and collaborations are useful in the effective establishment of new programmes related to nutrition interventions due to its multi-sectoral nature. Adequate and effective use of different communication tools in an attractive manner are essential in education and behavior change of adolescents. However, these opportunities are underutilized in Sri Lanka.

In conclusion, adolescent nutritional health is vital for a healthy adult in future, though it has received less attention. There is tippie burden of malnutrition among Asian adolescents including Sri Lankans. Among the micronutrient deficiencies iron deficiency is the commonest. Poor dietary behavior, sedentary life style and unfavourable environment are associated with the current trends in adolescent nutritional health. Behavior change is an important strategy in mitigating the nutritional trajectory of adolescents. That requires identification of motivators and barriers for healthy behavior. The innovative interventional programmes to improve the dietary behavior and lifestyle along with the improvement of environment are effective in long-run to produce nutritionally healthy adolescent population.

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Prof T W Wickramanayake Oration

Poor dietary diversity and nutritional adequacy: unveiling the nutrition paradox in Sri Lanka



Prof. Renuka Silva (Past President-NSSL)

Department of Applied Nutrition, Wayamba University of Sri Lanka

It is indeed a privilege to make this Professor Thomas Walter Wikramanayake oration in 2022 to honour one of the founder members of The Nutrition Society of Sri Lanka (NSSL) and an eminent scientist in the field of nutrition in Sri Lanka. Professor Wikramanayake contributed a lot for the nutrition education, nutrition science, research and policy and wrote some landmark publications in nutrition. I had a good fortune to work with him, although for a brief period of time, during my tenure as the President of the Nutrition of the NSSL as well as an early career academic. Remembering his always updated knowledge on nutritional issues inspired me to re-think about the dilemma of concurrent undernutrition and overnutrition problems in the country. The combination of underweight in children and overweight in adults, frequently coexisting in the same family, is a phenomenon in developing countries undergoing the nutrition transition including Sri Lanka. The Oration addresses the causes for the nutrition paradox by analysing the robust evidence and data from recent studies done in Sri Lanka.

The underweight is linked to poor maternal and infant health as well as childhood growth problems and compromised mental development, whereas obesity is associated with chronic diseases such as stroke, hypertension, cardiovascular diseases, type 2 diabetes, and certain forms of cancer. According to Demographic & Health Survey (DHS) in 2016 (Department of Census & Statistics, 2016) the prevalence of stunting, wasting and underweight of children under 5 years of age is 17.3, 15.1 and 20.5%, respectively. These prevalence rates categorise stunting as being of medium public health significance, wasting is of very high public health significance and underweight is of high public health significance. The prevalence of overweight children under 5 years of age is 2.0%. In addition to protein energy malnutrition, micronutrient deficiencies were found in children under 5 years of age. Nearly one third of the children aged 6-59 months were iron deficient. The prevalence of anaemia in children aged 6-59 months was 15.1%. Zinc deficiency (5.1%) and calcium deficiency (47.6%) were also reported in these children (Jayatissa et al. 2012; Jayatissa et al. 2014). Optimum growth during the intra-uterine period is critical since a child's future growth pattern is 'programmed' during foetal life. For a given BMI, South Asians have a higher percentage of body fat and more visceral fat than members of other populations (Yajnik 2004). This thin-fat phenotype is present at birth. Accelerated childhood growth is another risk factor for adiposity and insulin resistance, especially in children born small. Urban lifestyles, including poor diet and sedentary habits, promote further obesity, insulin resistance and type 2 diabetes. Therefore, prevention of non-communicable diseases (NCDs) must begin in utero and continue throughout the life course. The national average for LBW (14.5%) is below that for South Asia (27%) and is lower than the global average (15.7 %).

Overnutrition is also becoming a major public health problem over the past several decades. Studies have shown an increase in overweight children and adults over the past 2 decades especially. Considerably high prevalence of stunting (11.5%), thinness (39.9%) and anaemia (11.1%) among 6-12

years of age children has also been reported (Medical Research Institute, 2017). A recent survey among 5–18 year olds in urban Sri Lanka showed an obesity prevalence of 10.3% and overweight prevalence of 11.3% (Wickramasinghe et al. 2019). The DHS 2016 survey reported that 9.1% of ever married women were thin (BMI<18.5 kgm-2), and 45% were overweight or obese (BMI ≥25.0 kgm-2). Low pre-pregnant BMI<18.5 (22.6%), anaemia (31.8%) and iron deficiency (21.8%) are the problems among pregnant women (Jayatissa et al. 2017).

The familial coexistence of under and overnutrition is phenomenon observed in Sri Lanka. We studied 3000 mother-child pairs from urban, rural and estate sectors using multi-stage cluster sampling in 2015-16. The prevalence of underweight was significantly higher in mothers in estate sector (27.4%) compared with mothers in other two sectors (urban 7.9%, rural 14.2%). The prevalence of overweight was 35.1%, 37.2% and 17.9% in urban, rural and estate sectors, respectively. The prevalence of obesity (30.7%) was higher in mothers in urban sector compared with rural (16.9%) and estate (6.7%) sectors. Coexistence of two opposite forms of malnutrition (undernourished – stunted, underweight or wasted children of overweight/obese mothers) at the same household was observed in 24.2%, 27.4% and 51.4% households in urban, rural and estate sectors, respectively. Our results indicate possible a link between the women’s obesity and child malnutrition suggesting need of household rather than individual based approach in nutrition intervention.

Sri Lanka has shown limited progress towards achieving the diet-related NCD global nutrition targets. The country has shown no progress towards achieving the target for obesity, with an estimated percentage of 25.2%, 9.2% and 26.2% of Sri Lankan adults are living with overweight, obesity and centrally obesity, respectively. At the same time, the prevalence of diabetes in Sri Lankan adults was 7.9% in 2016 (WHO, 2017).

Unsound dietary habits, poor sanitation, poverty, ignorance and lack of access to safe water and health services are thought to be responsible for undernutrition. Changes in lifestyle and dietary habits as well as inactivity are associated with the occurrence of diet-related NCDs. Sri Lanka has been struggling with sparse data on dietary intakes of its population as it had never conducted a national survey on food consumption apart from occasional dietary surveys done by individual researchers or research groups.

We conducted a large scale study in 2016 to assess the dietary intakes of 2-5 year old children and their mothers (non-pregnant, non-lactating) covering urban, rural and estate sectors in Sri Lanka. The energy intake of women (1572 kcal) was significantly lower than the RDA for energy (1900 kcal). High prevalence of inadequate intakes was found for calcium, iron, zinc, folate, thiamine, riboflavin, vitamin C and vitamin A in all three sectors. The prevalence inadequate intakes ranged from 60% to 99% for energy, thiamine, riboflavin, folate, vitamin A, vitamin C and calcium, and 30% to 60 % for protein, iron, and Zinc. They achieved EAR of niacin and percentage energy from protein and carbohydrates. All women had energy intake from carbohydrates greater than the recommended level of 55%. Compared with the food-based dietary guidelines (FBDG), women consumed significantly lower number of servings of vegetables (1.1 servings/d), fruits (0.1 servings/d), dairy products (0.2 servings/d), fish/meat/egg/pulses (1.1 servings/d) except for cereals (9.4 servings/d). Relatively low dietary diversity score (DDS = 4 to 5 out of 9 food groups) indicate poor diversity of the diet. Studies done others have also found low dietary diversity with high carbohydrate consumption (Jayawardena et al. 2014), and diets fell short of meeting the Estimated Average Requirements (EAR) in Sri Lankan population.

Optifood linear programme (LP) identifies nutrient gaps and suggests food combinations the local diet can fill—or come as close to filling. The analysis helps identify local foods’ limits in meeting nutrient needs and test strategies for filling remaining nutrient gaps, such as using fortified foods or micronutrient powders. We used Optifood LP to identify micronutrients (calcium, vitamin C, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin A, iron and zinc) that are likely to remain low in the best diets based on locally available foods. Based on reported dietary intakes among women in the above study, the nutritionally “best” diets generated, with and without adherence (best diet which may deviate from median food pattern of food group) to dietary food patterns, indicated that only

vitamin B6 and vitamin B12 reached >100% of the RDA. It was difficult to select a diet that achieved RDAs for all but three (vitamin B6, vitamin C and vitamin B12) of the modelled micronutrients (maximized diets where the best-case scenario is >100% of the RDA). The remaining eight micronutrients that were modelled were identified as “problem nutrients” and likely to remain inadequate among this population, given the local food supply and food patterns. These problem nutrients were identified as “absolute problem nutrients” since they were <100% RNI in best-case scenario. However, 100% RNI of vitamin B6, vitamin C and vitamin B12 can be achieved in the best-case scenario (partial problem nutrients).

Energy intake of preschool children (968 kcal) was inadequate compared to the EAR (1470 kcal). Nearly 60% of daily dietary energy was obtained from carbohydrate by all children. Sufficient protein intake was reported but it should be noted that majority of the proteins come from cereal-based foods, hence the protein quality is questionable. The prevalence of inadequate intakes (<EAR) ranged from 75–90% for energy, calcium, thiamine, folate, vitamin C and vitamin A and 30–60% for others such as vitamin B6, vitamin B12, iron and zinc. The consumption of number of servings from food groups were well below the recommendations with a low dietary diversity (DDS 3.8 to 4.6 out of 7 food groups). The most commonly consumed foods were rice, dhal, egg and at least one vegetable.

LP analyses of pre-school children’s dietary intake indicated that it was difficult to select a diet that achieved RNIs for all but four (vitamin B6, vitamin C, vitamin B12 and folate) of the modelled micronutrients. The remaining seven micronutrients among pre-school children that were modelled were identified as “problem nutrients” and they were also identified as “absolute problem nutrients”. Apart from wider prevalence of undernutrition and micronutrient inadequacy, Sri Lanka is now facing ‘explosive’ epidemic of NCDs. NCDs account for 75% of all deaths in Sri Lanka while a fifth of all premature deaths is due to NCDs caused by tobacco use, unhealthy diets, harmful use of alcohol and physical inactivity. Moreover, trend analysis suggests that NCD mortality rates have been rapidly increasing during the past decade. Dietary intakes of Sri Lankans are not favourable in relation to dietary strategies aiming at prevention of NCDs. The typical Sri Lankan diet is high in carbohydrates (most of them are refined) and saturated fats, which comes mainly from coconut fat. Energy from saturated fat (□□ 16%) exceeds the maximum of 10% whereas, consumption of monounsaturated and polyunsaturated fats is below the optimum (unpublished data).

In conclusion, the latest data produced by us along with previous studies on dietary intakes of various groups in Sri Lanka shows markedly inadequate intakes of several micronutrients, especially in rural and estate sectors suggesting the need for population-based interventions to alleviate the nutrient inadequacy. Also, the road to the Sustainable Development Goals and the recommendations given in FBDGs are challenged for their feasibility in achieving the nutrition goals using our analysis of diets using LP. Food and nutrition literacy (FNL) is an emerging concept that emphasizes not only on personal knowledge and skills which enable people to “make appropriate nutrition decisions” and “plan, manage, select, prepare, and eat foods” (Vidgen & Gallegos, 2014). Therefore, food and nutrition literacy promotion through multi-dimensional interventions is suggested as an alternative strategy to tackle the diet related nutrition paradox in Sri Lanka rather than solely depending on conventional interventions that have already been tried and arguably failed.

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Symposium I: Aging, Chronic Diseases and Nutrition

Plenary Lecture

Aging and Non Communicable Diseases



Prof S A M Kularatne

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Aging is a natural phenomenon where the structure and function of the body decline with time and become susceptible to non communicable diseases (NCDs). Normally, all organ systems including brain, heart and the muscular skeleton system respond to aging and maintain the life in a reasonably good health during the complete lifespan. However, premature death, diseases and infirmity could result due to invited or uninvited NCDs which could to begin even during younger ages. Healthy lifestyle is an investment of old age, but this fact is not properly conveyed to younger people who consider living is for enjoyment and old age is faraway. Also, challenges are more during younger age in the today's world where market economy is dominant compared to traditional agriculture-based economy. This transformation is seen more in the developing countries than in the developed countries.

Medical science has advanced exponentially over the last 100 years and the modern technological advancements have been heavily utilized in the field of biomedical engineering. Thus, early diagnosis of NCDs are possible and for them interventional management has been developed at a heavy cost. The net result is increasing survival of people with NCDs who do not contribute for economy of the country due to comorbidities and disabilities, but they are a burden to the country due to their dependence. Therefore, prevention of NCDs is much important for a nation.

In the broader context, all known illnesses and diseases can be divided into two groups- communicable diseases (CDs) and NCDs. In the ancient world and even a century ago CDs were the main killer. Plague, malaria, smallpox, tuberculosis, epidemic typhus, typhoid, cholera are examples of such pestilences that kept population growth at a check and very few people had the chance to live up to old age. The early medical science was busy in finding answers to these diseases that resulted in the development of microbiology, discovering of antibiotics and vaccination. Apart of occasional epidemics and pandemics such as COVID 19, the importance of CDs is less in the globe as a health burden. Compared to NCDs, CDs are acute and has less long-term disabilities. According to the WHO, NCDs Kill 41 million people in the globe annually accounting for 71% of all deaths. Sri Lanka has the same NCDs death rate currently while CDs cause only 11% of all causes of mortality. This paradigm shift is great and never ending.

The WHO finds a significant number of NCD deaths occurring between the ages of 30-69 years and 85% of these premature deaths occurring in low-and middle- income countries. Cardiovascular diseases account for most NCD deaths followed by cancers, respiratory diseases and diabetes, all together accounting for 80% of all premature NCD deaths. Tobacco use, physical inactivity, the harmful use of alcohol and unhealthy diet are the risk factors of NCDs. These risk factors are linked to so many

contributory factors such as increased population growth leading to unplanned urbanization, aging, machinery based comfortable life, availability of salty, sugary, fatty junk foods and alcohol. The metabolic risk factors include hypertension, high blood sugar, hyperlipidemia and obesity. The risk factors and NCDs are interwoven and related to bad human behaviors most of the time.

Prevention of NCDs is a major priority of the globe and the WHO. The ministry of health in Sri Lanka has dedicated a unit for the NCD under a director. There are so many strategies such as screening, health education, regulations and guidelines are in operation as preventive methods. Healthy lifestyle is very much promoted. Programmes of management and rehabilitation of NCDs are also in place, but costly. Aging is productive and enjoyable if no suffering from NCDs. On the contrary, aging together with NCDs is a sin.

Symposium Lecture

Dietary habits and Non communicable Diseases



Prof. Ranil Jayawardena

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Sri Lanka is a low-middle income South Asian country with a population of over 21 million. Despite Sri Lanka's relatively good health status compared to the regional countries, during the last two decades NCDs have become the main cause of the mortality. Most of the diet associated NCDs have reached epidemic proportions in Sri Lankan adults, Although the causes of epidemic of NCDs is multi-factorial, recent life-style changes found to be the main cause especially unhealthy dietary habits. While rice being the staple food of Sri Lankans, carbohydrate intake accounts more than 70% of the total energy. Moreover, the average daily starch consumption has been found to be over 14 servings per day, exceeding the maximum daily recommendation for cereal (11 servings). This is primarily because, an average person's meal consists of three-quarters of rice and a small portion of vegetable and a small piece of fish or meat along with spicy curries. Sri Lanka have in addition reported very low level of fruit, vegetable, and protein consumption. Furthermore, with fats Coconut oil is the major contributor for saturated fats in Sri Lankan diet. Therefore, it is vital to reduce carbohydrate and coconut oil consumption, increase fruit and vegetables, protein to curb the prevalence of non-communicable diseases.

Symposium Lecture

The bidirectional link between metabolic syndrome and Mental Health



Prof. Shehan Williams

Professor in Psychiatry, Department of Psychiatry, Faculty of Medicine, University of Kelaniya

The high comorbidity between Metabolic Syndrome and Mental Health disorders warrants increased attention and action by all health professionals. Despite clear evidence for the bidirectional causal links, the problem is not addressed adequately.

Metabolic syndrome is defined as a set of chronic and associated features that increase risk of cardiovascular disease and type 2 diabetes mellitus, including central obesity, atherogenic dyslipidemia, insulin resistance and endothelial dysfunction. The prevalence of metabolic syndrome and mental health disorders are increasing globally. The COVID 19 pandemic has worsened the situation. The burden of these two conditions and the premature morbidity and mortality that they lead to cannot be ignored.

Research shows a bidirectional association between Metabolic syndrome and Mental Health disorders including schizophrenia, bipolar disorder, depression, anxiety, attention-deficit/hyperactivity disorder and autism spectrum disorders. Those with metabolic syndrome and consequent chronic, progressive and debilitating diseases like Diabetes mellitus develop depression and anxiety. Conversely, those with mental health disorders, neglect their physical health, do not seek and comply with treatment and have poor life style habits that result in metabolic syndrome.

Both biological and environmental factors contribute to this association. Lack of exercise and healthy eating habits, medication side effects and psychosocial factors are well recognised environmental culprits.

There are a number of shared underlying neurological and physiological mechanisms too that explain the high comorbidity between these two disorders. Inflammation is a state shared by both disorders, and it contributes to disruptions of neuro-regulatory systems (including the serotonergic, dopaminergic, and neuropeptide Y systems) as well as dysregulation of the hypothalamic-pituitary-adrenal axis. Genetic factors such as the demonstration of overlap between certain genes in diabetes and depression are shedding more light on the comorbidity. Furthermore, these disorders are transmissible to the next generation.

Symposium 2: Communicable Diseases, Health and Nutrition

Plenary Lecture

The use of Artificial Intelligence in the prevention and control of communicable diseases



Prof Samath Dharmaratne

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Artificial intelligence (AI) uses computer systems to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. AI models can help predict the location, timing, and the size of an disease outbreak, allowing policy makers to allocate resources effectively in the management of the incident. The novel coronavirus named Severe Acute Respiratory Syndrome- Coronavirus-2 (SARS-CoV-2), was first recognized in an outbreak in Wuhan, China in December 2019 and has since then swept the world into unprecedented turmoil. The World Health Organization (WHO) was compelled to declare the corona virus disease-2019 (COVID-19) a pandemic on March 11, 2020 when the total number of diseased amounted to more than 118,000 with a spread in over 110 countries. COVID-19 essentially pushed human civilization to a standstill. It tested the human response as communities, localities, countries, regions and the entire world's response to a global crisis. Social distancing with movement restrictions and lockdowns were initiated with unprecedented economic and social implications. In Sri Lanka the first patient with COVID-19 was reported on January 27, a Chinese female visiting the country. When the first local patient was reported on March 11, Sri Lanka initiated rigorous measures to reduce the spread of the disease. The government suspended all arriving international flights and ships, while imposing a nation-wide curfew on March 20.

What will happen in future pandemics and how can we prepare, prevent and control similar incidents (pandemics)? What have we learnt? What new methods, measures and techniques can be used? Still the experts are debating, discussing, and arguing on the best measures for the control COVID-19.

In this scenario, a description of the use of AI in the prevention and control of COVID-19 and in future similar communicable disease outbreaks will be discussed in this lecture. AI can complement traditional epidemiological methods that showed its limitations in the management of the COVID-19 pandemic. This lecture will take you on a journey to highlight the ways to use AI and other similar and related techniques in the prevention and control of communicable disease. COVID-19 may not be the last pandemic that will hit planet earth. Being prepared can save people. Collaborations between health and non-health sectors are important. Hope we do not meet another pandemic during the next 1000 years!

Symposium Lecture

Critical care management of nutrition in infectious Diseases



Mrs. Priyanwada Amarasekara

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Infectious diseases can cause life threatening circumstances that requires critical care; consist of a combination of specialised monitoring, treatment and attention. Patients in critical care are classified according to their severity of illness rather than their hospital location. Since nutrition is essential for life, even in critical care, early nutritional support on admission provides improved patient outcomes, reduced length of hospital stay, decreased duration of dependence on mechanical ventilation and reduced infections (Villet et al. 2005).

Infectious disease is a process caused by an agent, often a type of microorganism; bacteria, viruses, fungi, protozoans, and worms that impairs a person's health. In many cases, infectious disease can be spread from person to person, either directly (e.g., via skin contact) or indirectly (e.g., via contaminated food, air or water). The most important barriers to invasion of the human host by infectious agents are the skin and mucous membranes (the tissues that line the nose, mouth, and upper respiratory tract). When these barriers are compromised, a human will be susceptible to infectious diseases. However, the human body is not without defenses against these threats, for it is equipped with a comprehensive immune system that reacts quickly and specifically against disease organisms when they attack.

Nutritional assessment or requirement of a critically ill patient with an infectious disease is not that different from any other patient in a critical care unit. Nutritional screening and assessment are essential procedures requiring number of information on decision making for the most appropriate care plan and to determine the requirement. This includes anthropometry, biochemical and refeeding markers, clinical condition, dietary assessment, past medical history, environment and pathogenesis. Nutritional assessment provide valuable information to decide on nutritional and fluid requirement, route of administration, feed and feeding regime, parameters to be monitored.

Infectious diseases and malnutrition have always been intricately linked. Malnutrition plays a key role of a human being susceptible to infectious diseases and on the other hand suffering from an infectious disease can lead to malnutrition. Common complications of infections, include disorders of food intake, interference of nutrient absorption, and intermediary metabolism playing a significant and independent role in morbidity and mortality. When a patient is already malnourished, commencement of nutritional support, need to be done with caution due to risk of re-feeding. However traditional screening tools for determining the risk of malnutrition such as the 'Malnutrition Universal Screening Tool' (MUST) are not accurate in critically ill patients (Anthony, P.S. 2008). The current international guidelines recommend nutrition risk scoring e.g. Nutrition Risk Screening 2002 (NRS), Nutrition Risk in Critically Ill (NUTRIC) for all patients (McClave et al. 2016). Nutrition risk may distinguish between those patients who may benefit the most from nutrition support and those who may not. However, limitations exist.

Multidisciplinary approach is required for the care of the patient. Once the individual risk is assessed and deemed to be safe to commence feeding, the blanket regime could be started until a dietitian provides the nutrition care plan. For a critically ill patient who is unable to maintain their own nutritional intake, it is recommended that EN be initiated within 24-48 hours. A feeding protocol should be standard practice in a critical care setting to facilitate early enteral feeding. Volume based feeding is a relatively new practice which is being increasingly implemented by dietitians in critical care setting. This allows nursing staff to calculate the remaining daily feed volume to be delivered and to adjust the rate of feeding to accommodate. It is practical and safe to use EN in most critically ill patients.

Provision of energy is a balance between too little and too much- both representing with their own risk. Current data suggests that optimal energy provision may be 70% of measured energy expenditure (Zusman et al 2016) or 80% of estimated targets (Heyland et al. 2011) over the first week of Intensive Care Unit (ICU) stay when considering mortality as an outcome. Clinical condition of the patient (i.e. ventilated or non-ventilated) and the different phases of critical illness (catabolic vs anabolic/ recovery) should be considered when choosing an appropriate predictive equation.

However, infection control measures are to be followed strictly to avoid cross contamination. We have experienced the severity and impact of an infectious disease as we never have before during recent times with Covid -19 pandemic. There has being many changes in overall management of infectious diseases related to Covid -19 including nutritional care.

Estimating nutritional requirements in critically ill patients are challenging. With infectious diseases, it is more challenging causing certain deviations even from the standard practice. With recent experience of Covid-19 pandemic further emphasis on the importance of using feeding protocols should be a standard practice in the ICU to facilitate early enteral feeding. Enteral feeding is the route of choice and the need for parenteral nutrition should be considered on a case by case basis. Clinical judgement at the bedside is warranted at all times. Provision of nutrition support in critically ill patients is complex and requires the skills of a specialist dietitian. The 21st century provides new information and new challenges. With new technologies and political changes, it is hoped that a healthier, more disease-free, and better-nourished population will emerge. It is imperative that a critical care dietitian remains up to date with current literature and changes practice accordingly.

Symposium Lecture

Infectious disease, Immunity and Indigenous dietary approach



Dr Senaka Pilapitiya

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Sri Lanka has a rich heritage of Traditional Medicine (TM) and Complementary and Alternative Medicines (CAMs). These include Ayurveda, Siddha, Unani, and Indigenous medical system of Sri Lanka.

Plurality of TM/CAMs in Sri Lanka has led to sharing of knowledge and practices within them. Traditional home remedies (Ath-Beheth) and indigenous dietary approaches are largely influenced by these principles and practices. In Ayurveda and indigenous medicine “krimija roga” refers to diseases of infectious origin. Further, infectious diseases are also discussed under other categories of diseases such as “jvara ” which refers to diseases that manifest fever.

When comparing TM/CAM systems with the theories of modern conventional system of medicine it is imperative to appreciate the incommensurability of theories and principles which these systems are based upon. Ignoring this cardinal feature leads to many misleading and false interpretations, doing much harm to the logical foundations of the TMs and creating a sense of invalidity and obsolete nature of them in today’s context.

Ayurveda or indigenous system of medicine in Sri Lanka do not have a direct entity or concept that could be referred as to the immune system and immunity in today’s context. Therefore, more famous claims of “Immune boosting TM preparations or nutraceuticals” are totally misleading and do much harm to the authentic validity of these systems. Prevention and Resistance to disease and potentiating the body to overcome disease once Inflicted is discussed in-depth under different conceptual models. “Vyadikshamathwa” meaning ability to alleviate or eliminate inflicted disease is one such concept. According to Ayurveda “swastha” is the state of optimum health. Bestowing swastha is also a way of improving resistance to disease. In dealing with infectious diseases too, there are many ways explained to bestow “swastha”, capacitating the patient to battle the disease.

Further the concepts of dealing with “Agni” which denotes to some extent of dealing with digestive capacity, gut flora and metabolism in today’s context also plays an important role in improving the capacity to battle diseases including infectious disease.

Concept of “Ojas” in TM can be considered as a process of ameliorating the degenerative processes of aging and maintaining the vitality of body functions. It is considered as an important factor in improving the resistance to disease. “Balya” is a more direct concept that deals with ability to resist disease in TM. Hence according to TM, prevention of infectious disease and battling it once infected is done through a more complex approach with a multitude of interventions rather than a single drug or a food item.

Promoting health and battling of disease in TM is achieved through a combined approach consisting of “Ahara” (Food and Dietary Practices), “Viharana” (behaviour) and “Aushada”(Drugs). This is considered the standard approach of battling diseases and bestowing health in TM.

Ahara plays a main part in this combined approach. These concepts over time have influenced the people to pay a special attention to diet during illnesses. Some of such indigenous dietary practices are followed even today, though the exact underlying TM principle is not appreciated.

The concept of “Shad rasa” (6 types of tastes of a food) will determine the effect of a food on the body. The “prabhava” is the special property that a food or herb may have; unexplained by the shad rasa, which will bring about a specific effect within the body. Special properties such as ability to destroy “krimi” (infective microorganisms) will be considered as a prabhava of a food or a herb.

Based on different combinations of Rasa within a particular food, the usefulness of it for a particular disease state can be determined. Further, properties of food such as “lagu” (Light/easy to digest and absorb) and “Guru” (Heavy/ difficult to digest and absorb) will also be considered based on the disease state of the person.

Further the influence on the state of Agni is also considered in selecting the food items in diseased states.

Ayurveda also takes into consideration of the state of “Áma” in dealing with infectious diseases both during the period of active infection and the post infective period. Ayurveda believes many of the infectious diseases could lead to accumulation of Ama at varying severity and of period which could be considered equivalent to a concept of varying periods of post infectious subclinical inflammation in the body. Therefore TM has many dietary recommendations even for the immediate post recovery period to bestow “Swastha” or optimum health.

According to above TM principles even a simple dietary intervention such as advocating “Lunu Kanda” (Thin rice gruel) could have a significant impact on supporting the body to battle the disease. Understanding the fundamental principles behind dietary approaches in TMs associated with infectious disease would be very useful to appreciate the value of such interventions and to discard misquotes such as “immune boosting traditional preparations/food” which is not comprehensible to scientific minds. Further, this will pave way to incorporate such practices rationally in benefit of the patients and could open new avenues for research.

Symposium 3: Food Security and Nutritional Wellbeing

Plenary Lecture

Food Security and Nutritional Wellbeing in Sri Lanka: Implications for Food Price policies



Prof. Jeevika Weerahewa

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Sri Lanka is cited in international development literature as a well performing developing country in terms of health and education. Its performance with respect to food and nutritional wellbeing however is mixed. The country shows improvement in terms of food availability and accessibility as per the indicators of the food security suit of the Food and Agriculture Organization (FAO), but its performance with respect to food stability and utilization is not satisfactory. During 2018-2020, it was reported that 1.4 million people were undernourished, 0.3 million pre-school children were wasted, 0.3 million pre-school children were stunted, 1.8 million women in reproductive stage were anemic and 0.8 million adults were obese (FAO, 2021). Even though undernourishment decreased from 16.9% to 6.8% and under 5 mortalities decreased from 1.7% to 0.7% between 2000 and 2020, no significant changes either with respect to stunting or wasting among pre-school children have been observed. Approximately 18% and 15% of pre-school children paradoxically remained stunted and wasted respectively through the past two decades. The Global Nutrition Report lists Sri Lanka as a country that suffers from only one burden of malnutrition, which is anemia. Of the 13 targets for maternal, infant, and young child nutrition, Sri Lanka is off course with respect to 11 targets. The country showed no progress with respect to anemia and childhood wasting. It is on course only for childhood overweight and exclusive breastfeeding.

Nutritional status of an individual, particularly in developing countries like Sri Lanka, is largely determined by economic access to food which eventually is determined by affordability and cost of diet. According to the Status of Food and Nutrition Insecurity report of 2020, of the Sri Lankan population, 0.1%, 6.8% and 53.8%, could not afford an energy sufficient diet, nutrient adequate diet, and healthy diet respectively. In contrast, the same report published in 2021 shows an increase in over-weight among pre-school children (1.2 to 1.3%) and obesity among adults (4.1 to 5.2%) from 2012 to 2020.

Then there is the issue of shocks and their implications on both food and nutrition security. According to Singh et al. (2021), during the COVID-19 pandemic, half of the Sri Lankan households were either moderately (36%) or severely (14%) food insecure and the degree of food insecurity varied by wealth quintile and district. Central Bank (2021) states that during the pandemic, risks to food security were disproportionately aggravated for vulnerable groups of the population that were already facing food insecurity prior to its onset. The most vulnerable groups comprised individuals with limited or irregular income, who have limited emergency reserves of food and savings. These groups further comprised people with poor health, living in comparatively remote areas, certain groups of urban residents, people who have limited social networks, people with limited or no transportation facilities, and other vulnerable groups, such as the elderly, homeless or displaced people and vulnerable children.

Given this status with respect to food and nutrition wellbeing in Sri Lanka, it is pertinent to examine the factors that contribute to the outcome. Following Abdallah et al. (2021) and Deason et al. (2016), this note focuses on food prices. It provides an overview on how food prices are determined and how they differ or are linked or decoupled from the world market and assesses with the potential implications of price policies on food and nutrition security.

Determination of prices in domestic food markets – Options and Practices in Sri Lanka

Food prices like in any market are determined by demand and supply forces albeit without policy interference of the government. When food supplies are limited and/or when demand is high, food prices rise. Opposite happens in periods next to time of harvest and/or demand is less. Sri Lanka unlike some countries in south Asia does not have a public distribution system of food. The governments intervene in food markets primarily through imposition of ceiling prices and floor prices and government procurement. When ceiling prices (maximum retail prices) are imposed, prices get lower but only a limited quantities of food will be made available by the suppliers. Similarly, with floor prices (guaranteed producer prices), price level can be kept at a higher level, but only a limited quantity will be purchased by the food buyers.

When food markets are open to international trade and if the country is a small player i.e., lacking market power in the international market, the country is a price taker and food prices are determined by world price. When the government imposes taxes and/or subsidies on imports and/or exports, the domestic market prices adjust. In the presence of quantity controls, the domestic market forces largely determine food prices.

Sri Lanka is a small open economy and the country relies largely on the international markets for wheat, lentils, dairy, sugar, fish and vegetable oil to meet the domestic requirement. From among the food items produced in Sri Lanka, coconut oil, fish and spices are exported in fairly large quantities. International trade in vegetables, fruits, meat, and eggs is negligible.

The food prices determined by government interventions has several examples such as government procurement (in the case of paddy), tariffs and para-tariffs or Special Commodity Levy (SCL) on all food imports except for those are under import prohibitions (such as turmeric, black gram), export cess (tea, cashew.), floor prices (paddy) and ceiling prices (rice, sugar, coconut). In striking a balance between protecting farm producers and urban consumers, the government of Sri Lanka has been changing its policy stance and instruments quite frequently.

Trends and patterns in food prices –Sri Lanka vis-à-vis Rest of the world

A comparison of food prices in Sri Lanka vis-à-vis the rest of the world provides some interesting insights. A close examination of the movement of the Food Price Index (FPI) of the FAO and the food component of the Colombo Consumers Price Index (CCPI) during 2014-2021 reveals that the CCPI has been rising at a faster rate, has been more volatile and tends to be delinked with FPI i.e. indicating lack of integration with international food market.

Towards developing a food price policy for food and nutrition security

Among other things, government interventions in food markets are the key factors behind the above dis-integration. Food price levels directly affect not only food accessibility but also its availability and stability hence intervening in food markets should be done with utmost care. High food prices incentivize local food production and improves livelihoods of small farmers which positively affect local food availability and accessibility by the farming population respectively. It also enhances stability of food supplies as it reduces dependence on foreign supplies however they adversely affect food accessibility of non-farm population. Having an ad-hoc and unpredictable price policy regime is detrimental to food stability and food utilization as it affects dietary planning hence nutritional outcomes. It also discourages investments in the food industry.

A liberal and a predictable trade policy framework is conducive to achieve food and nutrition security of a nation. Though trade policies are not sufficient to ensure food and nutrition security of a country, experience in other countries indicates that by aligning domestic food prices to international food prices

through an open trade regime improves food and nutrition security. It can enhance food availability, accessibility and stability through its favorable effects on income growth, employment generation, poverty alleviation and women empowerment. Complementary policies are however required to safeguard the vulnerable who are left behind when such reforms are implemented, proper nutritional awareness to minimize consumption of unhealthy food as income increases, and food safety regulations to safeguard food quality and safety.

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Symposium Lecture

Policy Changes are negatively affecting Food Security of Sri Lankans



Prof Buddhi Marambe

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Agriculture in Sri Lanka has evolved over centuries and it currently plays a pivotal role in the economy of the country. The sector has contributed immensely to food and nutrition security, mainly through increased primary production and export earnings, and providing nutritious food, while ensuring sustainable use of natural resources of the country. At present, the agriculture sector (primary production) of Sri Lanka contributes to about 7% to the Gross Domestic Product (GDP; at constant market prices) and has a share of about 21.7% of the total exports. It involves 23.73% of the national labor force and occupies nearly 45% of the total land area.

It is important to note that the per capita availability of agriculture land in Sri Lanka has reduced from 0.17 ha in 1960 to 0.13 ha in 2018. With a slow but steadily growing population, the per capita land availability in Sri Lanka is much lower than that of the global average (approx. 0.65 ha in 2018) thus highlighting the importance of productivity enhancement as compared to increasing extent of cultivation, to increase the primary production from agricultural operations. The efforts made by the scientists in Sri Lanka since 1950s, with the introduction of the old improved rice variety H4 and new improved varieties (NIVs) since mid-1960s, the average paddy yield has increased from a mere 0.65 mt ha⁻¹ in 1940s to more than 4.7 mt ha⁻¹ by 2020, mainly by increasing the harvest index (HI) through breeding programmes and improved management practices such as judicious use of synthetic fertilizer and pesticides. Further, more than 98% of the paddy cultivated extent in Sri Lanka are currently occupied by the NIVs highlighting the fact that Sri Lankan farming community has embraced the technological advances to improve the land productivity and their livelihood.

Though the investments on research and development over the years have focused more on the rice crop, the maize and other field crop cultivations have also shown much progress in terms of productivity enhancement during the past decade, especially considering productivity enhancement and addressing climate change-related issues. For example, in response to the greater demand by the farming community for planting material of crop hybrids, the Department of Agriculture (DOA) has developed five maize hybrids that performs well as the imported hybrids. Currently, more than 85% of the maize cultivation in Sri Lanka depends on imported hybrid seeds for increased productivity and farmer profits. Maize is an important feed ingredient in the animal industry production industry in Sri Lanka. The DOA has also introduced two chilli hybrids (MICH Hy1 and MICH Hy2) since 2015, of which MICH Hy1 has been the most popular choice by the farming community owing to its high yield (about 35-40 mt ha⁻¹ of green chilli) and its ability to produce dry chilli. Currently, about 95% of the total annual dry chilli requirement of Sri Lanka (approx. 50,000 mt) is imported from India. As a measure to adapt to a changing and variable climate, two drought tolerant rice varieties (Bg251 and Bg314) and three drought escape varieties (Bg250, Bg252 and Ld253), all of which are short duration varieties in the 2.5 months age class, have also been released by the DOA. The Tea Research Institute (TRI) of Sri Lanka has also released the first drought tolerant tea cultivar (TRI 5000 series) to tackle the threats of climate change.

To avoid the misuse of technology, especially the agricultural inputs such as fertilizer and pesticides, the DOA has formally introduced the certification programme on Good Agricultural Practices (GAP). With a modest beginning in 2015, despite the certification process is done by the DOA and is free of charge, the GAP certification programme has gained momentum by the year 2020. Promotion of GAP certification to reach a wider farmer community would no doubt have reduced the misuse of agricultural inputs and cost of production while increasing yield, thus assuring stable production and availability of the produce to the consumers at an affordable price.

Despite the significant achievements in the sector, especially as a result of the green revolution and the efforts of the scientists, academia, private sector enterprises and farming community, the agriculture sector still faces unprecedented challenges that need to be tackled effectively to ensure further growth and to maximize its contribution to long term food security. Climate change and policy changes are two such human-induced challenges resulting in significant negative impacts on the progress of the sector. Irrational policy decisions taken in the recent past to ban the import of synthetic fertilizer and pesticides, have affected food and feed crop production (including rice, maize and vegetables) and export agricultural crops such as tea. This has become evident from the claims made at the field level by the farming community on poor crop growth and significant crop losses. Despite proposing an attractive concept for “transforming Sri Lanka’s economy into a green socio-economy with sustainable solutions to climate change”, the mechanisms adopted to convert the whole crop production sector of the country to organic or eco-friendly agriculture has not gained momentum and has not yielded the results anticipated by the policy makers.

The statement issued by the Presidential Secretariat on 22nd April 2021, prior to the decision made later by the Cabinet of Ministers, recognizes that the usage of chemical fertilizers leads to a better harvest. However, the statement further elaborates on the negative consequences caused by those agriculture inputs on human lives through environmental pollution that outweigh the profits or benefits, especially leading to a number of non-communicable diseases including kidney diseases, thus increasing the expenditure on the national health budget. According to the above statement released by the Presidential Secretariat, “..... only organic fertilizer would be used in the agriculture sector in the country in the future”. The extraordinary gazette notification issued on 6th May 2021 (No. 2226/48) has imposed a complete ban on importation of synthetic fertilizers and pesticides for agriculture purposes with immediate effect, aligning with the decision of the Cabinet of Ministers taken on 27 April 2021.

On 30th November 2021, realizing the ultimate negative impact of the decision taken, an extraordinary gazette (No 2256/23) notification was issued revoking the decision taken to ban the import of synthetic fertilizer and pesticides for agricultural purposes. Furthermore, on 3rd January 2022, the government also announced a relief package to the paddy farmers who would incur losses in production owing to implementation of the policy decision taken in April 2021. Absence of a pragmatic plan and apparent lack of understanding on the basic scientific principles of crop production, soil fertility, etc., have probably led to the ill-fated decision imposed to immediately ban importation of two key agricultural inputs with a view to realize the proposed conceptual approach. This presentation will focus on the progressive evolution of agriculture in Sri Lanka, counteracting the myths that have led to this unfortunate decision by providing correct scientific facts, anticipated production losses that would position the country in a precarious position in terms of food security in the future, and the possible way out.

Symposium 4: Safe Food for Healthy Future

Plenary Lecture

Food safety in the Era of COVID- 19 Pandemic



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The COVID-19 pandemic is a public health emergency of international concern due to its rapid and extensive spread throughout the world, its highly contagious nature and high mortality especially among the vulnerable populations (Olaimat et al., 2020). Since emergence in 2019, the pandemic is still a huge economic burden and a serious threat to human health throughout the world (Han et al., 2021). While all industries have been affected by the COVID-19 pandemic, the food industry has been facing a number of unique challenges. In terms of food industry, food safety, food security and food sustainability are considered as the most affected dimensions of food systems during the Covid-19 pandemic (Djekic et al., 2021). In addition, the availability of bioactive ingredients of food and functional foods can be considered as a significant issue that the food industry need to address as there is an increasing demand for such functional and therapeutic foods from health-conscious consumers around the world in the era of COVID-19 pandemic (Galanakis, 2020).

Viruses are an important food safety concern and have been associated with many foodborne disease outbreaks throughout the world. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the pathogenic virus that causes COVID-19 can be transmitted by respiratory droplets and small respiratory aerosols exhaled through breathing, talking, laughing, coughing and sneezing. Indirect contact of virus contaminated surfaces including food can also be considered as a possible transmission mode (Vella et al., 2020; Blocken et al., 2021). Even though the latter is not as greater of a risk compared to respiratory droplets and aerosols particles, this still raises concerns regarding food safety as this can lead to spreading of the virus between producers, retailers, and consumers (Galanakis, 2020). According to the Centres for Disease Control and Prevention, there is no evidence to suggest that handling food or consuming food is directly associated with COVID-19. Similarly, there is also no current evidence that covid-19 can be transmitted through drinking water (CDC, 2021). However, SARS-CoV-2 transmission can be possible along the food supply chains if an infected individual touches food, during production both pre- and post-harvest stages, processing/ manufacturing, distribution, storage, and consumption, and shortly afterward, another individual collects it and touches its eyes or mucous membranes of the mouth, nose, or throat (Galanakis, 2020). Although the exact origin of COVID-19 is still unknown, from the beginning of the COVID-19 pandemic, zoonotic transmission of SARS-CoV-2 was a concern (Han, 2021). Meat and poultry processing facilities and, in general all food processing environments can be considered as favourable environments for SARS-CoV-2 transmission because the virus thrives in lower temperatures and very high or very low relative humidity (Middleton et al., 2020). Although, there are reports that indicated coronaviruses have poor survivability on surfaces, such as food products or packaging (Yekta et al., 2021), metallic surfaces in food processing facilities can retain live viruses for longer than other environments as well (Middleton et al., 2020). Presence of the SARS-CoV-2 RNA

in feces of some patients has been reported and this shows the possibility of their fecal-oral route spread (Barrios et al., 2021; Yekta et al., 2021) which is another major concern in terms of food safety, because fecal-oral route is considered as a common pathway for transmission of foodborne viral infection (Miranda et al., 2019).

Currently, very limited published scientific papers have reported on the length of time that SARS-CoV-2 can remain viable on food, beverage or food-contact surfaces (Han, 2021). Clearly, this is an area that deserves more research. However, as per the available research findings, all precautions should be taken into consideration in ensuring the prevention of the human-to-human transmission of SARS-CoV-2 via food systems. Targeted workplace interventions and prevention efforts that are appropriately tailored to all workers in food systems is necessary (Waltenburg et al., 2020). As COVID-19 and food safety is very important and also a complex issue, the WHO has developed two main guidance documents to support the food supply chain. The first document specifically addressed the food businesses (WHO, 2020a) and the other focused on authorities responsible for national food safety control systems (WHO, 2020b). Food safety is everyone's business including primary producers/ farmers, food workers, retailers and consumers (Lipp et al., 2021). Everyone in the food system needs to work together not only to keep our food safe, but also security, and our food systems operating in a sustainable manner in this challenging time. Hence, instructions from authorities should be rigidly followed. Hand hygiene including regular handwashing with soap and clean water, use of hand sanitisers particularly before food preparations, handling and eating is one of the easiest ways of avoiding virus transferring to food. In addition, wearing masks in the public, maintain respiratory system hygiene, and avoiding from direct contact with individuals who are having symptoms, should be considered (Yekta et al., 2021). Further, quarantine, social and physical distancing and vaccination play a crucial role in managing food safety concerns in the era of COVID-19 pandemic.

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Symposium Lecture

Technology and Food Safety: Facts and Myths of Genetically Modified Food and Organic Food



Dr Laura Privalle

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Today we will be discussing myths and facts about our food supply. Specifically, surrounding the safety of agricultural biotechnology products. I was asked to discuss both genetically modified food and organic food but I will really focus only on genetically modified food. With regard to organics, I would just like to say that the main myth is that no chemicals are used in the cultivation of organic products and this is not true. Organic growers avoid synthetic pesticides and rely instead on “natural” ones. Chemicals, albeit natural ones, are applied to these products. Nutritionally, these products are identical to conventionally produced products and I will not be saying anything more on organic foods.

Genetically modified crops or those produced through biotechnology have been on the market since 1996 – or over 25 years. A common concern is the idea that insufficient safety testing has been conducted on these products. Today I will describe the extensive safety and evaluation process that these products receive. Another concern is that long term effects may be unknown. In the 25 years these products have been on the market, no instances of adverse effects have been identified. Over 1 billion livestock have been fed these products with no issues encountered. Another facet of this same concern is the worry over unintended effects. Only a few have been encountered so far and these have been beneficial – the best example is the reduction in mycotoxin contamination associated by insect-resistant corn. By reducing the insect wound sites, fungal diseases are reduced hence the reduction in mycotoxins. This is an unintended beneficial effect. The final myth to be addressed is the question of whether biotech products lead to an increase in pesticide application. The answer is no according to ISAAA.

In today’s global economy, there is a high degree of international trade for Ag Biotech Products. The crops with the largest acreage are the community “row” crops – corn, cotton, soybean and canola. There are a relatively few production countries and many more importing countries. All those with functioning regulatory systems are involved in reviewing the safety of these products as it is mandatory worldwide; most regulations follow Codex Alimentarius guidelines. The safety assessment considers food and feed as well as environmental safety. Approval is granted only if authorities conclude that the biotech product is as safe as its conventional counterpart.

The safety assessment itself is conducted at many levels, only two of which will be described today. The gene and its source are considered, where it gets inserted into the plant genome, the protein, which is considered to be the “active ingredient”, encoded by the gene. We will focus on this aspect of the safety assessment as well as the concept of substantial equivalence that addresses the question of whether the plant performs similarly to its conventional counterpart with respect to agronomic and compositional parameters. This directly influences the food and feed safety. Furthermore, the environmental impact is analyzed.

Proteins, encoded by genes, do not typically represent a hazard. They are a single chemical class and are universal in all organisms. Proteins are large and generally labile. We have evolved to digest the proteins we eat and take the amino acid building blocks to construct our own proteins. However, there are some bad proteins – toxins and allergens that we must avoid introducing into our biotech products. Risk is a function of hazard and exposure. If either component is zero, the risk of that product is also zero. This cartoon shows the different risk possibilities of a lion and a cat. If there is no exposure to the lion there is no risk. If there is no hazard by the cat there is no risk. For a biotech product, we ensure that the risk is low and at the same time, the exposure is also low.

The protein safety assessment takes a weight of evidence approach. There are two tiers, the basic – hazard identification and supplementary – hazard characterization. For crop protection products, if no hazard has been identified, the characterization is not conducted. However, for biotech products, regardless of whether there is a lack of hazard identification, the supplementary studies are required by some regions of the world. The basic tier consists of collecting information on the history of safe use of the protein and protein/gene source. It helps to understand the mode of action or function of the protein as well. Bioinformatics is used to compare the protein sequence to known allergens and toxins. We also characterize the expression of the protein to get an idea about the potential exposure. Understanding the stability of the protein also contributes to understanding the potential exposure. The tier two or supplementary studies would include an acute oral single limit dose 14 day mouse study and a subchronic 28 day, repeat limit dose, mouse study plus any hypothesis driven studies such as sera screens that may be undertaken as a result of the outcome of the bioinformatics analysis.

In the acute oral single dose study, the dose may reach levels equal to a 75 kg man eating a lot (50 tons) of corn at a single sitting. The other concept I wanted to discuss today is substantial equivalence. The question being addressed is how similar to its conventional counterpart is the biotech product with respect to agronomic performance, composition, impact on the environment and wholesomeness. Today I will just discuss the composition.

Composition analysis is conducted looking at the major nutrients and antinutrients associated with this crop. Samples are obtained from multiple locations in a randomized complete block design study that includes the biotech product, perhaps treated and not treated with a trait-specific herbicide, its conventional counterpart and multiple reference varieties. Each crop has its own antinutrients, but many of the nutrient classes overlap. These components represent about 95% of the compounds found in each grain.

Wholesomeness studies are conducted regardless of if the composition is shown to be identical to check for unintended effects. These include, a 90 day rat study, 42 day broiler study and a 56 day catfish study. Likewise, many of these grains are processed into fractions which may be consumed. The fractions are analyzed not only for the newly expressed proteins but also for their components.

I have two slides that I have borrowed from Crop Life International that demonstrate the rigor with which the global regulatory system functions. Each product is reviewed multiple times by many governmental agencies around the world and sometimes within each country. In the US, for example, 3 agencies are involved and in South Korea 5. Each product is reviewed an average of 8 times (8 different countries or regions), with soybean closer to 12 times. Furthermore, within each product there may be an overlap of the newly introduced proteins. For instance, 36 different products contain the pat gene, so its gene product has been granted 253 approvals.

Biotech products have been rapidly adopted around the world and have been approved in 70 countries, they are grown in 26 countries on millions of hectares by both large and smallholder, resource poor growers. Overall yield has increased, pesticide application has decreased and farmer profit has greatly increased.

In summary, I would just like to reiterate the facts that I stated at the beginning. Extensive safety studies are done, no safety issues have been found in the > 25 years these products have been on the market and no unintended adverse effects have been found. Furthermore, there is a reduction in the amount of pesticides applied as a result of the adoption of biotech solutions in agriculture.

Plenary Lecture

Technology and Food Safety: Facts and Myths of Genetically Modified Food and Organic Food



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The global population growth over the past century has also led to the substantial increase in demand for food. Based on the United Nations report [1], world's population will surpass the 9.7 billion people by the year 2050 and this number is projected to climb well over 11 billion by the year 2100. If these numbers were compared to the global population only few years ago (2015), there will be a 53% more people requiring food and water supply in addition to medication, shelter and education [2]. Furthermore, the demographic areas that significantly contribute to this rapid growth include the regions of Africa and South Asia and in particular the individuals aged between 15-24 and aging populations (65 and over). Consequently, this will also result in different food consumption patterns that may affect the increase in requirements for several food items (cereals, fruit, vegetables, animal proteins) [1]. Therefore, it is evident that consumer behaviour and the increase in the number of people living on the planet are significantly influencing the future prospects of food and agriculture.

This increase of the overall population also presents increase in two very polarised sub-population extremes that contribute to further health and well-being challenges. In one extreme, we are faced with increased share of the population that is undernourished. In this context, we can expect negative health consequences resulting in hunger, increased infectious disease, lower immunity and increased rates of early mortality. In addition to the consequences of global pandemic due to the SARS-CoV-2 pandemic, in 2021 it was estimated that nearly 1 billion people across 93 countries do not have enough food to eat, making that year one of the worst years for world hunger [3]. On the other side of the spectrum, we are faced with increased rates of obesity with nearly 2 billion adults classified as being overweight and more than 35% of this population being obese [4, 5]. Therefore, it is plausible to propose that there will be an increase in adverse cardiometabolic and psycho-cardiological health effects associated with obesity and overweight. With such bleak picture of the global population in addition to the non-viral consequences of the current pandemic, the food science and human nutrition as well as the food innovations are proposed to be the most influential areas for the management of population future demands. This includes the rapid advancements in areas of agri-food technologies, food supply, health, therapeutics and number of other overall life areas wherever the food is focus point.

It is well established that the increased technological developments applied in the current food systems have been responsible for the increases in safety, nutritional value and beneficial health outcomes [6]. However, these developments are not always perceived well by the consumer. Although the technological advancements in several other industries have received positive responses, the consumer perception of improvements and application of technological advancements in food industry do not share the same path and in some cases have been received with strong resistance. In particular,

technological application in foods (such as genetical modification) are most often viewed with negative attributes while foods that are promoted for their naturalness and produced with minimum human interference are inherently viewed with positive attributes [7].

Genetically modified (GM) organisms have been a topic of intense debates for the last few decades and in some countries such as Australia and countries of the European Union, there are strict regulatory frameworks around the GM crops [8]. Although it has been nearly 30 years since the introduction of GM crops on the commercial market (production and consumption), there is still a relatively small number of products that are being developed, approved and in common usage. In United States (US), the regulatory authority has deemed that GM crops are no different in the terms of human consumption to their counterparts and more than 90% of soybeans, corn and canola that are grown in US are based on the GM technologies.

Essentially, genetic engineering can be divided in two very broad and large categories; the transgenic and transgenic-free types. The transgenic method has been introduced since early 1980's and involves the transfer of genetic material from unrelated species that is associated with a desirable trait into a target organism. In contrast, the transgenic-free methods were developed by utilising the 'natural' or 'artificial' genes were used to modify the genetics of the target organisms that are associated with desirable traits [8]. In the past two decades, the cultivation of transgenic crops has significantly increased global agricultural productivity with benefits to increase in crop yields (up to 22%) and farmer profits (up to 68%) [9]. The major traits for which GM crops have been developed and approved for use include herbicide tolerance, insect and disease resistance, stress tolerance and nutritional enhancement. Nevertheless, the insertion of 'foreign genes' also creates the concerns towards the chances of gene flow between the transgenic crops and its 'wild' relatives. Furthermore, the lateral transfer of antibiotic resistance genes to microbes in the environment and potential adverse health effects (toxicity and allergenicity) were proposed as main points of concern. Due to this, the transgenic crops in particular have faced a lack of public acceptance in many countries.

Number of scientific associations have reported a wide agreement among the scientists that GM food is safe for human consumption [10]. Nevertheless, public's general opinion mainly reports that scientists do not fully understand the health effects of GM foods. The major contributor to the public scepticism and lack of support towards the GM food products is proposed to be a consumer scientific illiteracy towards the GM foods and perceived risks, unnaturalness and lack of perceived benefits of the GM food products [7]. Furthermore, the concerns over the safety and environmental sustainability of the GM foods are extremely heightened by the public, social media activism, political agendas and misconception aired by some mainstream media and political parties [8].

In contrast, there is a rising interest in developed and developing countries on the consumption of foods that are grown organically. This is of consumers particular interest mainly due to their concerns about the environment, food safety, animal welfare and human health [11]. Although the main driver for organic food consumption is environmental benefit, the perception that organic foods are 'healthier' than their conventional counterparts also contributes to their increased demand. Nevertheless, the association and link between the two (organic food and health) are not necessarily unequivocally supported by food and nutrition science despite the consumer belief that organic foods are healthier [12]. Despite this, the findings of several large cohort studies also supports the association of frequency of organic foods consumption with the lower risk of cancer [13] and metabolic syndrome [14] among others. The main reasons attributed to these findings are commonly ascribed to the non-existing use of synthetic pesticides and fertilizers which can be harmful to human health [15]. Furthermore, the findings of relatively recent systematic literature review by Vigar et al (2020) suggest that current evidence does not allow for definitive statement on the health benefits of organic dietary intake [16]. Importantly, the authors acknowledge the findings of observational studies linking the association between the health benefits with organic food consumption.

Despite the increasing evidence on potential health benefits of organic food consumption, some of these foods have also been linked to food-borne illnesses outbreaks. In particular, *Escherichia coli* O157:H7

and *Salmonella* spp are being reported as the major pathogens associated with organic foods. These two pathogens are also economically damaging with significant costs to the overall food and health industry [17].

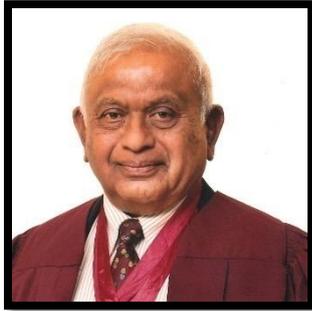
Therefore, the aim of this plenary lecture is to provide the summary of latest scientific evidence on the current global state of genetically modified and organic foods while focusing on consumer demands, their perception of certain food healthiness and naturalness and taking into account the food supply needs of an increased planetary population.

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Symposium Lecture

National Food Control System: Food Safety and Quality Assurance in Sri Lanka



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Food safety and quality assurance in Sri Lanka is addressed by the Ministry of Health through a multi-agency system, with Food Act 26 of 1980 serving as the primary regulatory document. There are twelve secondary Acts under different ministries and institutions. Secondary Acts are not linked with the primary Act. This situation creates limitations in harmonization of food regulations and results in divided responsibilities. The 1980 Act, and regulations under it, address mostly the food quality checks with little emphasis on food safety. Current Food Act and regulations have not expanded to keep up with global trends in food safety management. In Sri Lanka food quality control operates through end-product testing, which has been a failure in all countries. Testing of samples withdrawn at the market (end-product) cannot ensure meaningful food safety, as the food has been already consumed by the time hazards are recognized through laboratory tests aiming legal actions. From a nutritional point of view, food safety handles the anti-nutrients.

In addressing food safety, a science-based preventive approach with monitoring of hazards at entry points of foods needs to be carried out. Results or observations in such a system is used to implement control measures at the critical entry points of hazards. The foods need to be checked immediately after the critical control points to assure hazardous agents are eliminated. The prevention through process specific control measures needs to become a responsibility of the food manufacturer or producer, with monitoring along the food chain.

European Commission, United States of America, Canada, United Kingdom, Australia, Japan, China, India, Bangladesh, Pakistan, and many developing countries have established Food Safety Management Acts and regulations, implementing food safety and quality assurance through checks and controls along the food chain - a farm to folk approach. This shift of emphasis was implemented during 2008 to 2013. Today, the food importing countries in the developed world require the importer to ensure that the food processing entities in exporting countries operate Hazard Analysis Critical Control Points (HACCP) system effectively. Prior to export of foods, the manufacturer needs to provide accredited process certificates and accredited laboratory test reports to ensure the products meet safety and quality standards stipulated in the importing countries. The operation of accredited food testing laboratories and accredited certification services follow the terms and conditions laid down by the International Organization for Standardization (ISO). ISO is a nongovernmental organization functioning as a federation of standard bodies from more than 160 countries. The bodies follow the same guided practices to ensure that foods produced in all member countries maintain equivalent standards and adhere strictly to agreed and documented specifications. Though the system is voluntary, foreign buyers demands the application of accredited process certification and accredited food testing systems to ensure equality of safety and quality of foods.

At the global level there are three bodies addressing the broad subject of food safety. They consist of International Plant Protection Convention (IPPC) addressing plant health, the World Organization for Animal Health (Office International des Epizooties = OIE) addressing animal health and Codex Alimentarius Commission (Joint body of the Food and Agriculture Organization and World Health Organization) addressing safety of processed foods through guidance and specifications. The three organizations collectively provide science-based guidance to implement the two food related agreements of the World Trade Organization (WTO). The two agreements guiding food safety globally are “The Agreement on Sanitary and Phytosanitary Measures” (SPS) and “The Technical Barriers to Trade Agreement” (TBT). The SPS agreement ensures all countries maintain equivalent level of sanitary and phytosanitary measures in food trade, preventing the cross-border entry of harmful organisms and diseases threatening natural environment and food chain of each country. The TBT agreement ensures that technical regulations, standards, and conformity assessment procedures are non-discriminatory and do not create unnecessary obstacles to trade. At the same time, it recognises WTO members' right to implement measures to achieve legitimate policy objectives, such as the protection of human health and food safety. In the developed countries food safety management systems following the above guidelines are monitored by the national food authorities with emphasis on product testing before marketing. All countries are expected to maintain the standards covered by above principles equally to local food production and movement of food across country borders. Operation of this system needs a work force with higher level of knowledge on food processing and food safety to be applied along the food chain on a case-by-case basis.

Sri Lanka needs to follow the procedures and concepts discussed in the above paragraphs to ensure food safety and quality in par with other countries. While food safety remains the responsibility of the Health Sector in all countries, they operate food safety management bodies at national level combining the knowhow and activities of all organizations responsible for food production (farming), processing, transport, storage, and marketing. The national bodies operate through combined actions of Plant Health Scientists, Animal Health Scientists, Food Technologists and Medical Scientists working together in a single administration. The functions of the scientists working together in a food safety management authority spread over areas of food legislations, preparation of food standards, food control management, food inspection & enforcement, food borne disease surveillance, import & export controls, accessing and applying rapidly changing knowledge on food technology & food safety actions, verifications of the effective functioning of the food safety system at all levels in the country, functioning of accredited laboratory food testing services, examining effectiveness of accredited food process certification services along the agro-food chain, and combination of information, education, communication & training addressing consumer empowerment.

Sri Lanka needs to develop a national food safety body where at least the two main ministries associated with ensuring food security and food safety namely, Health (food safety for public good) and Agriculture (Plant and Animal Health addressing food safety) working as equal partners, with other relevant ministries associating with the body. The author has proposed a three-tier system consisting of an apex Food Safety Authority (addressing policy), Inter-ministerial committee (handling administration, upgrading the current Food Advisory Council) and a Food Safety Secretariat (upgrading the current Food Control Administration Unit to deep technical and implementation aspects). The proposed Food Safety Secretariat needs to be operated by four or more food safety officers with wider qualifications to address activities in the ten areas identified above efficiently. The job descriptions and the standard operating procedures for management officers and each stakeholder organization need to be established. The food control laboratory testing functions should be redesigned aiming maximum outputs based on available resources, rather than geographical areas of jurisdiction. The system needs to prepare horizontal food safety standards using the principles applied in developed countries but focusing on Sri Lankan needs in line with the food production, processing, marketing, preparation, and consumption patterns. This concept will be presented. Implementation of this concepts requires political commitment at the highest level of the country and a deep understanding of the institutions on the overall needs of the country for consumer protection and meeting export needs, rather than operating in small defined territories of specialties.

ABSTRACTS OF ORAL PRESENTATIONS

Development of Self-management Education Materials for Individuals with Type 2 Diabetes Mellitus

H.P. Gunawardena^{1*}, P.P. Jayawickrama¹, B.M. Samaraweera¹, N.V.S. Dharshika¹ and A. Chandrasekara¹

Diabetes self-management is a timely need during the current pandemic. Providing education and necessary skills in managing the condition ensures the proper disease management. Therefore, the current study was conducted with the objective of developing education materials for type 2 diabetics to assist them in the self-management process. Perceptions of diabetic patients and diabetes management team on educational materials were collected using individual interviews and focus group discussions. Considering the comments and suggestions received from the diabetics and diabetes management team and national importance, few educational materials were designed using MS Word, Photoshop software and Sony Vegas Pro Video Creation application. An interactive report card, booklet for dietary management, diabetes cook book and a video clip were designed to aid the self-management education. Report card was designed to see the progress of clinical outcome of the patient. Dietary education booklet contains all the necessary instructions for adapting a healthy dietary pattern whereas video clip aided in motivating the patients in engaging the physical activities. Designed materials had simple and specific messages, tips for dietary and lifestyle changes, and appropriate illustrations and visuals to increase the understanding. Draft material were reviewed by a panel of healthcare professionals and type 2 diabetics for its content validity and face validity respectively. Developed materials were perceived as well-designed, attractive, interactive and use-friendly by the users. Contents were improved according to the comments and suggestions received from healthcare professionals. Views of the patients with diabetes mellitus were incorporated in improving the readability and understandability of the material contents thus revised materials were self-explanatory and interactive enough to suit even the diabetics with low literacy. Therefore, it is expected to use the developed materials effectively in serving the type 2 diabetics to attain proper disease management through self-management education.

Keywords: *Diabetes; diet; education materials; lifestyle; self-management*

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A Cross-sectional Study on the Prevalence of Food Allergies among Young Adult Students at University of Peradeniya, Sri Lanka

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Food allergy (FA) is a potentially life-threatening condition and a current global health concern. Even though research on FA has addressed Sri Lankan children and adolescents, there is a paucity of information on young adults. This study aimed at uncovering the FA prevalence, major food allergens and the gender effect on FA among undergraduates of the University of Peradeniya. A structured and anonymous online questionnaire was distributed among undergraduates of all faculties. Consequently, valid responses from 1169 participants within 19 – 29 years of age were statistically analyzed. Participants whose symptoms were repeatedly occurring to a particular food within 2 hours of ingestion or physician-diagnosis evaluation were considered as FA subjects. Respondents with a previous history of FA and currently avoiding the food were also counted. The study population had a male: female ratio 2:5. The self-reported FA prevalence among undergraduates was observed at 17.5% which was significantly higher among females (n=167, 20.3%) than males (n=37, 10.6%) (P=0.00006) using the chi-squared test. The recognized major food allergens were crustaceans (5.8%), fruits (5.8%) and meat (5.6%), followed by fish (3.9%), vegetables (3.8%), milk and dairy products (2.0%). Prevalence of FA among males reported the highest for meat (n=11, 29.7%) followed by crustaceans (n=8, 21.6%), fruits and fish (n=7, 18.9%) whereas FA prevalence among females reported the highest for fruits (n=61, 36.5%) followed by crustaceans (n=60, 35.9%) and meat (n=55, 32.9%). The main allergenic fruits observed include pineapple and ‘rambutan’ as characterized by mild and moderate symptoms. However, respondents with moderate symptoms have avoided the offending food. Discovered FA prevalence rate (17.5%) seems to be higher than previously reported values from other Asian countries. Thus, FA is a crucial health issue among young adults in Sri Lanka. Further studies are required to reveal the relationship between FA and associated factors.

Keywords: *Food allergens, self-reported food allergy, university of Peradeniya, young adults*

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Association of Low Dietary Protein Intake with Sarcopenia among Elderly

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Sarcopenia refers to a progressive syndrome characterized by age-related or non-age-related degenerative loss of muscle mass, muscle strength and physical performances. Sarcopenia includes several consensus definitions with different cutoffs and assessing methodologies. Protein intake is positively associated with preservation of muscle mass in the older adults. A community based cross-sectional study was conducted in Kurunegala district with a sample of 152 elderly aged over 65 years obtained by convenient sampling method to determine the prevalence of sarcopenia, dietary protein intake and dietary diversity. Height, weight, waist, hip, mid-upper arm, and calf circumferences were taken. Hand-grip muscle strength of prominent hand, 4-meter usual phase gait speed and muscle mass were used to determine sarcopenia, which is defined as low hand-grip strength and/or low gait speed along with low muscle mass. A single 24-hour dietary recall with multiple pass approach was used to assess dietary intake and diversity of the participants. Prevalence of sarcopenia in the study population was 19.7% with higher prevalence in females (22.4%) over males (17.1%). Mean protein intake of the study population was mean \pm SD; 29 \pm 12g. Mean dietary diversity score of the population was mean \pm SD; 7 \pm 1.2 out of 12 food groups considered. Majority (94%) of the study population did not meet the recommended daily protein intake. There was a significant positive moderate association of hand-grip muscle strength ($r = 0.47$, $P = 0.0001$) and gait speed ($r = 0.38$, $P = 0.0001$) with dietary protein intake. The odds ratio of sarcopenia with dietary protein intake was 0.92 (95% CI 0.87-0.96, $P = 0.001$). In conclusion, increased dietary protein intake may have favorable effects on sarcopenia of aging.

Keywords: *Gait speed, hand-grip muscle strength, lean mass, older adults, sarcopenia*

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Antioxidant Properties of Chips made from Banana Pseudo-stem

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This study evaluated the antioxidant properties namely total phenolic content (TPC), total flavonoid content (TFC), antioxidant capacity, and DPPH radical scavenging activity of chips made from banana pseudo-stem. The banana pseudo-stem paste was prepared as follows; banana pseudo-stems were cleaned by removing sheaths and other unwanted materials, cut into small pieces, boiled at 80 °C and ground to a paste using a grinder. For chip preparation, the dough was formulated by partially replacing wheat flour with boiled banana pseudo-stem paste at a ratio of 100:0, 80:20, 70:30, 60:40, and 50:50, where the dough was prepared with 100% wheat flour was considered the control. The uniformly cut dough was fried at 180 °C for 10 to 15 minutes with coconut oil. The ratio of wheat flour and banana pseudo-stem paste 70:30 was selected as the best formulation after sensory evaluation. The best formulation and the control samples were extracted in ethanol (70%) and the extract was used for the analysis of antioxidant properties with 3 replicates. The best-formulated chips had higher TPC (0.60±0.032 mg gallic acid equivalent/g dry matter), and TFC (1.12±0.08 mg catechin equivalent/g dry matter) compared to the control (0.49±0.001 mg gallic acid equivalent/g dry matter, 1.02±0.032 mg catechin equivalent/g dry matter of TPC and TFC, respectively), whereas antioxidant capacity was high in the control (2.23±0.018 mg ascorbic acid equivalent/g dry matter) when compared to the best-formulated chips (2.05±0.10 mg ascorbic acid equivalent/g dry matter). Higher DPPH radical scavenging activity (IC₅₀ 0.3±0.004 mg/mL) was observed for ethanol extract of the best-formulated chip than that in the control (IC₅₀ 0.38±0.006 mg/mL). Based on the findings, it could be concluded that banana pseudo-stem can be used to prepare antioxidant-rich healthy snacks by partially substituting wheat flour.

Keywords: Antioxidants and antioxidant activity, banana pseudo-stem, chips

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Engaging a Group of Women in Selected Areas of Sri Lanka to Identify the Determinants of Non-Communicable Diseases using the Health Promotion Principles

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In Sri Lanka, Non-communicable diseases (NCDs) are emerging as a leading cause of mortality and morbidity. NCDs were responsible for 71% of annual deaths in Sri Lanka in 2014. Females are more likely to be victims of NCDs. This study aimed to identify the determinants which increase the risk of NCDs among adult females in selected areas of Sri Lanka. It is a part of a long-term study to address the risk of NCDs among women. This study was a qualitative study done with 15 randomly selected families which were feasible to contact in a distant mode in Hambantota, Matara, and Ratnapura districts of Sri Lanka. They were engaged in experience-sharing sessions and facilitating continuous discussions in a distance mode according to health promotion principles where the community took ownership of the process. Observations, in-depth interviews, and focused group discussions in distance mode were used in partnership with the community to identify the determinants of NCDs. The community identified multiple structural determinants at the individual, household, and community levels. Some identified determinants were; age, occupation, hereditary factors, unhealthy dietary patterns, high junk food consumption, sedentary lifestyle, peer influences and busy life. Community was facilitated to prioritize the most influential determinants depending on their favorability and addressability. With the facilitation of the facilitator, participants improved their capabilities to analyze and identify the similarities and relationships between determinants at different levels. Focus group discussions and tally mark methods were used to prioritize the determinants. High intake of junk foods, sedentary lifestyle, and unhealthy and irregular food habits was prioritized in partnership with the community. Health Promotion principles can be used to approach lay communities effectively for identifying determinants that increase the risk of NCDs.

Keywords: *Determinants, health promotion, risk of NCDs, women*

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Development of a Guide for Sodium Content in Sri Lankan Foods for Hypertensive Patients

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Evidences suggest a direct relationship between dietary sodium intake and hypertension. Since the absence of any guide on sodium content in foods available in Sri Lanka, this study was conducted to develop a guide for sodium content in commonly consumed food items. A preliminary survey was conducted to identify the dietary patterns, sodium intake, and commonly consuming foods of 30 hypertensive patients, age ranged between 30-60 years through pre-tested interviewer-administered questionnaire, two 24-hour recalls, food frequency questionnaire, and direct observations of food available at markets and home-gardens. The sodium content of commonly available Sri Lankan foods was determined using Sri Lankan, Indian and ASEAN food composition tables and referring food labels. Foods were categorized according to the sodium content in 100g of food into low (<120 mg/100g), medium (120-600 mg/100g), and high (>600 mg/100 g) sodium containing foods. The results of the preliminary survey showed that the mean daily intake of sodium (2298 ± 751 mg) was higher than the recommended daily intake (1500 mg/day) of hypertensive adults. A guide (booklet) was developed by including functions of sodium, sodium-rich foods, tables of foods categorized according to sodium contained in per-portion of studied hypertensive people commonly consumed 61 food items and the way of referring the booklet. Further, the developed booklet consists of photographs of one-portion of commonly consumed foods with sodium content in mg. High, medium and low sodium containing foods were indicated with the colours of red, yellow and green, respectively. The evaluation of structure, content and illustrations (pictures, tables, photos) of the developed booklet was done by five professionals including three dietitians and two nutritionists individually. The overall evaluation results were, the size of the booklet and quality of printing were appropriate, the information was adequate for the target group, the photos showing the one-portion of different types of food were good and using household measurements to show one-portion of different foods was appreciated since easiness of understanding the sodium intake from different foods. This developed booklet will be a useful guide to select low-sodium foods for hypertensive patients to manage their condition and for healthy adults to prevent hypertensive condition.

Keywords: *Guide-booklet, hypertension, sodium contents*

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Diet Quality of Adult Men in Sri Lanka Based on the Diet Quality Index-International (DQI-I) and Other Diet Quality Indices

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Measuring the quality of diet in terms of its variety, diversity, adequacy, moderation and overall balance is crucial as poor diet quality is a leading and preventable cause of non-communicable diseases (NCDs). This study aimed at assessing the quality of the diet among a selected group of adult men using different diet quality indices considering Diet Quality Index-International (DQI-I) as the main parameter. DQI-I has been used in multiple international studies to describe dietary variety, moderation, adequacy and balance. This analysis has been carried out as a part of ongoing survey among 185 apparently healthy adult men aged between 30 and 60 years. Related dietary information was obtained using a 3-day diet diary including two weekdays and one weekend and a Food frequency Questionnaire (FFQ). DQI-I score, Food Variety Score (FVS), Dietary Diversity Score (DDS), Nutrient Adequacy Ratio (NAR), and Mean Adequacy Ratio (MAR) were computed. Overall DQI-I score for the study group was 58 (Theoretical max; 100) including variety, adequacy, moderation and overall balance scores were (mean, theoretical max) 13.5 (20), 22.5 (40), 19 (30) and 3 (10), respectively. FVS, DDS, and MAR for study group were 10, 8.4 (out of 13 food groups considered), and 0.81, accordingly. This data further depicted inadequate intake of fruit (0.6 servings/day), vegetables (1.7 servings/day) and fiber (8.8 g/day) as well as excessive intake of saturated fatty acid (16% of total energy) and sodium (3968 mg/day) among study participants compare to recommended levels. DQI-I showed positive significant correlations ($P < 0.0001$) with FVS, DDS, NAR of energy, most of micronutrients and MAR. In conclusion, the overall diet quality was not a satisfactory level in adult men. DQI-I is a useful indicator to determine the overall diet quality as it revealed significant positive associations with overall nutrient adequacy, total energy and majority of micronutrients.

Keywords: Adult men, dietary diversity, diet quality index, food variety, moderation

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Changes in Fruit and Vegetable Consumption during the COVID-19 lockdown in Sri Lanka

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The crisis related to the COVID-19 pandemic has tremendously affected the food consumption pattern of individuals. Although it is recommended to consume fruits and vegetables to support immunity, adhering to the dietary guidelines was a challenge due to COVID-19 containment measures. To examine the changes in the purchase and consumption of fruits and vegetables in Sri Lanka during the COVID-19 lockdown period. A national-level online cross-sectional survey was conducted from the 27th of May to 2nd of June 2021, using Google forms to investigate the changes in purchase and consumption of fruits and vegetables among adults. The questionnaire was disseminated through social media platforms. Of the 3621 respondents aged ≥ 16 years, 63.0% and 43.3% reported decreased consumption of imported and local fruits purchased from the market, respectively. Imported fruit intake has significantly reduced among respondents aged <30 years, males, respondents living in municipal areas, who are employed, and those with lower monthly incomes compared to respectively that of, respondents aged 40 years and older, females, rural population, unemployed and the highest monthly income group ($>200,000$ LKR). The leafy vegetable consumption increased significantly with 40.7% of respondents reporting an increased intake while the consumption of low-country and hill-country vegetables has declined. During the pandemic, 48.9% of the respondents have increased the consumption of home-grown fruits and vegetables. Respondents living away from Colombo (OR 2.021; 95% CI, 1.762-2.318, $P<0.001$) and who live in rural regions were more likely to claim a higher intake of home-grown fruits and vegetables than employed males and people living in municipal areas (OR 0.689; 95% CI, 0.574-0.827, $P<0.001$). COVID-19 lockdown led to significant changes in the consumption pattern of fruits and vegetables. Imported and local fruits purchased from the market have declined. Although the leafy vegetable consumption has risen, consumption of both upcountry and low country vegetables tended to decrease. Intake was affected by the monthly income and area of the resident. There is a need for a nutrition strategy to strengthen the resilience of vulnerable households to consume a diverse diet in adequate amount even in times of a pandemic.

Keywords: *Fruits and vegetables, consumption, home-grown, COVID-19, Sri Lanka*

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Knowledge, Attitudes and Practices on Diet and Nutrition among a Group of Sri Lankan National Athletes: An Online Survey in 2020

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Appropriate nutrition has a profound effect on the performances of athletes. Understanding their present knowledge, attitudes and practices is of utmost importance in changing their dietary behavior. The objective was to assess knowledge, attitudes and practices on diet and nutrition among a group of Sri Lankan national athletes. After obtaining the ethical approval, a pretested online questionnaire was used to collect the data. Scores were calculated allocating one for a correct answer. Data was analyzed using descriptive statistics. This online survey was carried out with the participation of 75 (56% males) national athletes aged 16-45 years. Data showed 69% of them had received an education on nutrition. Majority were non-vegetarians (71%), non-smokers (88%) and never had alcoholic beverages (60%). About 60% of them know about the Food Based Dietary Guidelines (for Sri Lankans). The overall knowledge on nutrition and dietary practices of the study group were in satisfactory level (mean (SD) score 8.1 ± 1.2). Main sources of getting nutritional advices were newspapers/electronic media/social media (26%), sports physician (23%), coach (23%) and nutritionist/dietician (15%). About 40% of them believed that regular intake of high amount of water lead to weight gain and 56% believed that fasting is the best method to lose weight. The majority (57%) of the participants think expensive foods are better and important for enhance performances. Dietary practices score was of 8.2 ± 1.5 . More than 50% of the athletes follow some good practices, but only about 19% were following all the good practices. They encountered inability of affording healthy food as a barrier to follow healthy practices (50.7%). The basic knowledge and the practices on diet and nutrition of the majority were satisfactory. However, individual level overall improvement is necessary. Facilitating reliable sources for proper nutritional advice needs to be streamlined. This study identified the requirement to facilitate a healthy diet to the national athletes by providing adequate financial support.

Keywords: Athletes, knowledge, nutrition, practice, sports

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Contribution of Coconut Fat to the Diet of Women Living in the Rural Setting of Sri Lanka

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Coconut oil, milk and scrapes are the major ingredients in the habitual Sri Lankan diet. Reliable local information on the dietary energy and macronutrients intake as well as coconut consumption levels is lacking. This study has assessed the dietary energy and macronutrients intake and contribution of coconut to the total energy and fat intakes of adult women in Sri Lanka. A cross-sectional survey was carried out with 408 adult-women, who represented rural setting. Socio-demographic and lifestyle characteristics were collected by an interviewer-administered questionnaire. Habits of coconut consumption were assessed by a qualitative food frequency questionnaire. Energy and macronutrients intakes were determined by a 24-hour recall. Recipes of food dishes were dissociated to quantify the amounts of coconut in the diet. The energy intake of women (mean age: 33 ± 6 years) was 1765 ± 390 kcal/d and total fat intake was 46 ± 18 g/d, which accounted for 23 ± 7% of the total energy intake. Saturated fatty acids (S), monounsaturated fatty acids and polyunsaturated fatty acids (P) intakes were 32 ± 14 g/d, 5.7 ± 3.2 g/d and 2.4 ± 1.1 g/d, respectively. The P:S ratio was 0.08. Coconuts contributed to 14 ± 6% of the total energy, 54 ± 21% of the total fat and 68 ± 26% of the total SFA intakes. Coconut milk was the major source of coconut fat (33 ± 20%) in their habitual diet followed by coconut scrapes (15 ± 14%) and coconut oil (6 ± 8%). In conclusion, coconut milk was the major individual contributor of fats and saturates in the high saturated-low polyunsaturated fat diet of women in the rural setting in Sri Lanka.

Key words: *Coconut, coconut fat, energy intake, macronutrients intake, saturated fat*

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Antiuro lithic Effect of Watermelon (*Citrullus lanatus*) Juice in Patients with Urolithiasis: A Clinical Trial

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Urolithiasis is the hard deposits made of minerals and salts in the urinary system. Dehydration, certain diets, obesity, certain medical conditions and medications are among the major causes of urolithiasis. Watermelon is known to have a protective effect against urolithiasis. This study was designed to investigate the antiuro lithic effect of watermelon juice using serum and urinary biochemical parameters. A randomized controlled clinical trial was conducted among patients with urolithiasis (n=20) admitted to Urological Surgical Unit, Teaching Hospital, Karapitiya and community-dwelling healthy individuals without a history of nephrolithiasis (controls, n=20) aged 20-70 years. Both groups of subjects are randomly assigned to one of two groups of control or treatment groups. Patients and controls were separately randomized into watermelon juice treatment (200 g watermelon in 500 mL of water) and water treatment (500 mL). Each arm out four, contained 10 individuals. Drinking of either watermelon or water was completed within half an hour. Patients and controls were on a routine diet during the intervention. Fasting blood samples and spot samples of urine (morning) were collected before and after 3hrs of the respective treatment. Samples were analyzed for pH, calcium, phosphorus, magnesium, urate and creatinine. Data were analyzed using descriptive statistics, paired-t and Mann-Whitney U test as appropriate. The average urinary calcium levels were significantly reduced from 10.0 to 7.7 mg/dL in watermelon juice-treated patients (p=0.032) compared to water-treated patients. pH of urine significantly increased (5.9 to 6.2; p=0.026) while creatinine decreased (124.7 to 79.7; p=0.028) in watermelon treated healthy participants compared to the controlled group water treated healthy participants. Serum urate, magnesium, creatinine were significantly reduced (p<0.05) in watermelon-treated patients. However, similar observations were seen in water-treated patients and healthy controls as well. The study results revealed that the use of Watermelon juice treatment caused favorable changes in urinary and serum biochemical parameters suggesting the potential effect of antiuro lithic effect. Further studies are required to delineate the findings.

Keywords: Antiuro lithic effect, urolithiasis, watermelon

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Indigenous *Lactobacillus acidophilus* Strains to Combat Foodborne Pathogen *Listeria monocytogenes*

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Foodborne outbreaks are critical issues concerned with global food safety. Food safety hazards are in different forms; biological, chemical, and physical. Hazards should be identified and controlled throughout the food manufacturing processes. Microbiological hazards occur when food is contaminated with potentially lethal or pathogenic organisms such as bacteria, viruses, and fungi. *Listeria monocytogenes* is a foodborne pathogen that causes listeriosis, resulting in severe nervous system disorders, abortions, or potentially fatal gastrointestinal illnesses. Currently, antibiotics are used to treat listeriosis. The development of antibiotic resistance in pathogenic as well as commensal bacteria is a current global health issue. As a consequence, alternative strategies, such as biological control, are being investigated. Based on this objective, two strains of indigenous *Lactobacillus acidophilus* (K1 and T4b), previously isolated from spontaneously fermented buffalo milk in Kantale, Sri Lanka, and identified molecular biologically by the authors were tested *in vitro* for their potential to combat *L. monocytogenes* (NTCT 11994). *Lactobacillus* spp. are usually stating as non-pathogenic and safe. To determine antagonistic activity, the agar well diffusion technique was implemented. Supernatants prepared from *L. acidophilus* were transferred to wells on *L. monocytogenes* containing BHI agar plates and incubated at 37 °C. Inhibitory zones were measured after 24 hours. Tests were conducted in triplicates. Both strains of *L. acidophilus* showed promising antagonistic effects on *L. monocytogenes*. T4b was the strain with the largest mean zone diameter (13.50 ± 0.55 mm), followed by K1 (10.78 ± 0.83 mm). Thus, *in vitro* data proves the possible uses of *L. acidophilus* strains as bio-control agents against foodborne pathogen *L. monocytogenes*. This would ensure the natural prevention of *L. monocytogenes* foodborne outbreaks and establishes the safety of food.

Keywords: Bio-control, buffalo milk, food safety, *Lactobacillus acidophilus*, *Listeria monocytogenes*

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Assessment of Quality of Coconut Oil and Sesame Oil Available in Jaffna District, Sri Lanka

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Consumption of edible oils that are adulterated with poor quality oils is a major threat to human health. This study was aimed to determine the quality of coconut oil and sesame oil available for sale in Jaffna district emphasizing mainly adulteration. A total of 27 samples of branded and non-branded oils (coconut oil: branded-7, non-branded-14 and sesame oil: branded-4 and non-branded-2) were randomly collected from sales outlets in Jaffna district and analyzed for free fatty acid (FFA) content, iodine value (IV) and peroxide value (PV) using standard methods and fatty acid profile by gas chromatography. Parameters were compared with the standard values of Food Act No.26 of 1980 and Codex Standards. FFA content and PV of all samples agreed with the standards. IV of 52% of coconut oil samples and 50% of sesame oil samples agreed with the standards. Among coconut oil samples, 3 out of 7 (42.85%) branded and 5 out of 14 (35.71%) non-branded samples had significantly higher IV (up to 13.90 ± 0.01) than standard (7-10). Among the branded sesame oil samples, 1 out of 4 (25%) had slightly higher IV (121.36 ± 0.84) than standard (104-120), whereas 1 out of 2 (50%) non-branded sesame oil samples had significantly higher IV (131.63 ± 0.04) than standard. The samples that did not agree with the standard IV are suspected to be adulterated with other oils. Suspected coconut oil samples contained lower lauric acid content and higher palmitic acid and linoleic acid contents than standard. Suspected sesame oil samples contained caprylic, capric and lauric acids and higher palmitic acid and lower linoleic acid contents than standard. In conclusion, 52.3% of coconut oil and 33.3% of sesame oil samples were suspected to be adulterated with other oils. Further studies are needed to confirm the adulteration and the type of adulterants of these edible oils.

Keywords: Adulteration, coconut oil, fatty acid, iodine value, sesame oil

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A Study on Perception and Consumption of Herbs among Sri Lankans

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Bioactive compounds in herbs can prevent and manage a number of Non Communicable Diseases (NCDs), which are public health issues in Sri Lanka. Although there is evidence on the use of herbs in traditional medicine, relatively less attention is given to determining whether people currently know and use the herbs. The present study investigated the socio-demographic factors affecting herb usage; and the frequently and rarely utilized herbs. A pre-tested questionnaire was forwarded to respondents through social media, for data collection and 417 responses were obtained. SPSS and AMOS statistical software were used for data analysis by confirmatory and exploratory factor analysis, which indicated significant correlations ($p < 0.05$) between perception and consumption of herbs and socio-demographics such as gender, ethnicity, education, and NCD presence. Out of a list of 39 herbs, pennywort (*Gotukola*), curry leaves, ginger, lime and garlic were the topmost herbs known by the majority for their health benefits. The top five herbs consumed by the majority included ginger, garlic, curry leaves, turmeric and lime. Jackfruit leaves, *Kothalahimbutu*, neem, *Rasakinda* and bael were the least consumed. Some respondents knew the health benefits but did not consume the herbs. Others consumed herbs even without knowing the health benefits. The main purposes of using herbs included overcoming common cold/fever and strengthening immunity. Nearly 80% complained of undesirable and bitter taste of herbal preparations. About 92% did not report any undesirable effect after herb consumption, but a few experienced stomachaches and vomiting. About 80% of the respondents agreed of a shortage of professionals with adequate knowledge of herbs. The majority showed a lack of knowledge on herb-nutrient and herb-prescribed drug interactions. In conclusion herb usage varies with the socio-demographics of the population; and curry leaves, ginger, lime and garlic are the predominantly known and utilized herbs. Limitations exist in knowledge, attitude and utilization of herbs among Sri Lankans.

Keywords: Attitude, behavior, knowledge, non-communicable diseases, socio-demographic

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Influence of Breed and Feeding System on Fatty Acid Composition of Cow's Milk in Sri Lanka

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Polyunsaturated Fatty Acids (PUFA) and Monounsaturated Fatty Acids (MUFA) in milk fat are considered beneficial fatty acids to human health whilst Saturated Fatty Acids (SFA) increase the risk of coronary heart diseases. Studies on milk fatty acid composition in relation to different breeds and type of feeding system are scanty in Sri Lanka. Therefore, the present study was carried out to evaluate the effects of breed and feeding systems on the fatty acid composition of milk. Thirty-two milk samples were collected from individual animals of *Bos Taurus* (BT): (Pure breed Friesian or Jersey; n=12), *Bos Taurus* Cross (BTC); (Friesian × Jersey; n=6) and Crossbreed (CB); (Sahiwal × Jersey; n=14), under Grazing (GR), Cut and Fed (CF) and Total Mixed Ration (TMR) feeding systems respectively. Total of 40 ml of milk from each animal was collected proportionately based on milk production from morning and evening milking for analysis. Milk fat was extracted and methylated according to the standard protocols and analyzed using a gas liquid chromatography. Data were analyzed as one-way Anova using Minitab-16. Percentages of total SFA in milk from CB (55.64^a±0.96) cows were lower (p<0.05) than BTC (59.72^b±1.96) and BT (56.15^a±1.33) cows. The content of C_{18:1}(oleic) and Conjugated Linoleic acid (CLA:*cis*-9,*trans*-11 octadecadienoic acid) was higher (p<0.05) in milk obtained from cows in GR and CF feeding systems (16.14^a±1.95, 0.62^a±0.0.19 and 14.82^a±1.36, 0.49^a±0.08 % respectively) than TMR (10.91^b±1.01 and 0.22^b±0.06 %) feeding system. It can be concluded that milk fat from cross-bred animals (Sahiwal x Jersey) is healthier due to comparatively low SFA content. Additionally, beneficial fatty acid content (Particularly MUFA and *cis*-9, *trans*-11 CLA) of milk fat can be further enhanced by more roughage-based diet (Such as grazing or giving more roughage through cut and feeding system) than high concentrate feed.

Keywords: Gas liquid chromatography, milk, monounsaturated fatty acid, polyunsaturated fatty acid

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Acute Effect of Watermelon Juice Consumption on Blood Pressure in Prehypertensive Adult Men

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L-arginine can decrease blood pressure by increasing the bioavailability of nitric oxide, an endothelial-derived potent vasodilator. L-citrulline is highly concentrated in watermelon, and effectively converts into L-arginine. Although some studies have demonstrated the differential effects of watermelon supplementation on blood pressure, no study has explored the acute effects of watermelon consumption on blood pressure. This study aimed to determine the acute effect of watermelon juice consumption (WJC) on blood pressure over 3 hours in prehypertensive adult men. A single-blind, randomized, crossover, placebo-controlled study was conducted in 10 prehypertensive adult men (mean \pm SEM: ages 44 ± 3 years; mean \pm SEM body mass index (in kg/m^2): 26.7 ± 0.5 in kg/m^2). After fasting, overnight, participants consumed 1 kg ($\sim 1000\text{mL}$) of watermelon juice or a placebo drink consisting of sucrose, glucose, and fructose at 0 min on two separate occasions. Blood pressure and finger-prick blood samples were collected before and regularly after the drinks for 180 minutes. A significant test drink*time interaction with decreasing trend in systolic blood pressure and pulse pressure were observed after WJC compared to placebo drink ($P = 0.009$). The incremental area under the curve (iAUC) for systolic blood pressure was lower after the WJC than after the placebo drink (mean \pm SEM: -6.6 ± 4.1 compared with -3.1 ± 3.4 mm Hg x 180 min x 10^2), with a similar trend for pulse pressure. No significant acute effects of WJC were observed for diastolic blood pressure and glucose. In conclusion, watermelon was shown to have differential effects on postprandial change in systolic blood pressure.

Keywords: Acute, blood pressure, randomized crossover placebo-controlled, watermelon

Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka (Application No: 202009H111).

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Study on the Use of Artificial Sweeteners and Total Sugars for Non-Alcoholic Beverages available in the Sri Lankan Market

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The use of artificial sweeteners in Sri Lankan beverage industry has significantly increased with the introduction of traffic light colour coding system by the Ministry of Health in Sri Lanka. The aim of this study was to investigate the levels of total sugars and the presence of nonnutritive sweeteners in 53 carbonated beverages from 4 reputed companies and 20 fruit drinks from 5 manufacturers. An HPLC method was used and found that 15.7% of carbonated beverages and 25% of fruit drinks contained total sugar levels of more than 11g/100 ml. Further 57.8% of carbonated beverages and 75% of fruit drinks had total sugars in the range of 2-11 g/100 ml while 26.3% of carbonated beverages reported less than 2 g/100 ml. When soda products were excluded, the average total sugar content of the tested carbonated beverages was 10.7 %. Most of the products with amber and green colour coding were found to contain a nonnutritive sweetener or a blend of nonnutritive sweeteners. As a single sweetener steviol glycosides was in 42.5% of carbonated beverages and 30% of fruit drinks, while sucralose was in 5% of carbonated beverages and 30% of fruit drinks. Acesulfame-k was found in carbonated drinks only. The blending of sweeteners acesulfame-k and aspartame was in 5% of carbonated beverages while the sucralose and steviol glycosides was in 10% of carbonated beverages. In conclusion, it is evident that manufacturers are using artificial sweeteners in non-alcoholic beverages to maintain their sweetness in amber and green colour-coded carbonated beverages.

Keywords: *Acesulfame-k, aspartame, carbonated drinks, steviol glycoside, sucralose, sweeteners*

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Addressing Unhealthy Dietary Practices and Improper Lifestyles to Reduce the Risk of Non-Communicable Diseases by using Health Promotion Approach in Semi-Urban Village, Anuradhapura District

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Non-communicable diseases (NCDs) are responsible for 41 million deaths each year around the globe. In Sri Lanka, over 80% of deaths were reported due to NCDs in the year 2020. Unhealthy dietary practices and improper lifestyles play a major role among the risk factors for NCDs. The objective of the study was to reduce the risk of NCDs using a health promotion approach by addressing unhealthy dietary practices and improper lifestyles. The sample was comprised of 20 mothers in age of 35-50. The intervention had been carried out for one year. Focus group discussions were conducted to make aware of NCDs. Determinants of NCDs risk were identified and prioritized by mothers with the facilitation. Unhealthy dietary practices, including high consumption of oil, sugar, salt and junk foods and improper lifestyles, including being overweight and physical inactivity were prioritized as determinants. The interventions were planned and implemented by mothers. Pasting paper scales on coconut oil bottles, starting to use small spoons to serve sugar and salt, changing depth plates into flat plates, collecting junk food packets to measure junk food usage, gardening, and maintaining BMI cards were used to address the prioritized determinants. Indicators and interviewer-administered questionnaires were used to measure the progress of interventions. Qualitative and quantitative data were analyzed using thematic analysis and descriptive statistics, respectively. According to the results, mothers were able to reduce monthly coconut oil, sugar, and salt consumption by 70%. The frequency of buying junk food has reduced by 60%. Home gardening was started by 40% of the mothers. Vegetable consumption in households was improved by 30%. Considerable mothers (15%) were able to maintain healthy BMI levels by reducing their weight. Therefore health promotion approach is an appropriate method to reduce the risk of NCDs by addressing unhealthy dietary practices and improper lifestyles among communities.

Keywords: *Dietary practices, Health promotion approach, Non-communicable diseases, Overweight, Physical inactivity*

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Changes in Dietary and Substance Use Behaviour among Office Workers in Matara District during Covid-19 Pandemic Lockdown

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Covid-19 pandemic poses a massive impact on human health, causing lifestyle and behavioural changes through social restrictions. Studies on lifestyle and related behaviour during Covid-19 pandemic are sparse and are a timely need to identify measures for optimizing population health. The purpose of this study was to describe the perceived changes in dietary habits, smoking and alcohol use in office workers in Matara district during the lockdown/curfew due to Covid-19 pandemic. A cross-sectional survey was conducted among 270 office workers in Matara district using an online questionnaire. Data were analyzed using SPSS software and Chi square test was used to assess the associations between variables. The mean age (SD) of the sample was 33.2 (7.9) years and 56% were males. Regarding dietary behaviours, a majority reported healthy changes such as reduced consumption of sugary beverages (58.5%) and fast/processed food (58.8%) and increased consumption of home-made meals (92.9%), drinking water (81.8%) and consuming herbal drinks (77.4%). Healthy dietary changes had no significant association with gender, residential sector, educational status, income, job category or working time. Regarding changes in substances use, 36.6% of the alcohol users increased alcohol consumption and 33.6% reduced consumption, whereas 13.8% have completely stopped consumption. A healthy change in alcohol use was associated with male gender and higher educational status ($p < 0.05$). Among smokers, a majority (52.9%) have not changed frequency, however, around twenty-six percent (26.4%) have reduced and twenty percent (20%) have completely stopped smoking. A significant positive association was detected between a healthy change in smoking habits and male gender, lower job categories and lower-income categories ($p < 0.05$). According to the results, healthy changes in dietary habits, smoking and alcohol consumption were common among office workers in Matara district during the lockdown due to Covid-19 pandemic. Health education should be continued to sustain these healthy behaviours, while implementing targeted interventions for high-risk socio-economic groups to promote healthy behavioural change.

Keywords: Covid-19, dietary habits, office workers, Sri Lanka, substance use,

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Dietary Intake and the Prevalence of Inadequacy of Preschool Children in Urban, Rural and Estate Sectors in Sri Lanka

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Sri Lanka is one of the countries in the world where a significant number of children remain malnourished despite the economic growth and development in the country over the past decades. In 2016, the prevalence of stunting, wasting and overweight among under 5-year-old children in Sri Lanka was 15.1%, 17.3% and 2%, respectively. Understanding the dietary intake is vitally important for designing intervention programmes that address the nutrition needs of the children. This study aimed to determine the energy and nutrient intake of 3-5 year-old children in urban (n 1200), rural (n 1100) and estate (n 700) sectors in Sri Lanka. A total of 3000 children (51.8% boys) were selected from three sectors using multi-stage cluster sampling and conducted in 2015-16. Dietary intake was assessed using 24-hour dietary recalls taken in two non-consecutive days. Usual intakes and distributions of energy and nutrients were estimated using PC Software for Intake Distribution Estimation (PC-SIDE). More than 75% of the children had a total caloric intake lower than recommended. Mean energy intake was significantly lower in children in the rural sector (990 ± 350 kcal) than the urban (1026 ± 314 kcal) and estate (1043 ± 367 kcal) sectors. Children in the urban sector showed significantly higher nutrient intakes except for vitamin C compared with those in the other two sectors. The prevalence of inadequate nutrient intakes of the study sample was ranged from 75–90% for energy, calcium, thiamine, folate vitamin C, and vitamin A and 30–60% for vitamin B₆, vitamin B₁₂, iron and zinc. A higher proportion of children in the rural sector had inadequate amounts of iron, zinc, iodine and vitamin B₆, compared to children in the other two sectors. The proportion of children who had inadequate calcium (75-81%), thiamine (75-77%), vitamin C (82-90%) and vitamin A (70-88%) was similar in all three sectors. In conclusion intakes of many micronutrients of preschoolers in studied all three sectors were markedly inadequate compared with the recommendation whereas higher prevalence was found in rural and estate sectors. The study suggests the need for population-based interventions to alleviate the nutrient inadequacy among the pre-school children.

Keywords: Adequacy, diet, intake, nutrients, preschool

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Association of Major Dietary Constituents and Glycemic Load with Body Mass Index of Newly Diagnosed Patients with Type 2 Diabetes Mellitus

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Intake of carbohydrate, fat, protein, fiber and glycemic load is a known determinant of body mass index (BMI) and is, therefore, a useful component in managing an appropriate BMI. Data focusing on dietary intake and its association with BMI particularly newly diagnosed type 2 diabetes (T2DM) subjects are sparse in Sri Lanka. The present study aimed to assess the association of dietary carbohydrate, fat, protein, fiber intake, and glycemic load with BMI in patients with newly diagnosed T2DM. A cross-sectional study was conducted among 158 newly diagnosed patients with T2DM attending the University Medical Clinic, Teaching Hospital, Karapitiya. Data on demography and dietary intake were collected using a pretested structured questionnaire and a 24-hour dietary recall, respectively. The glycemic load of the food was calculated by multiplying the reported glycemic index of the food items by their carbohydrate content intake in grams. The BMI was calculated. The patients were divided according to the quartiles of intake of each dietary component. The association between dietary intake and BMI was assessed using multiple linear regression. BMI showed positive associations with carbohydrate intake and fat intake. The individuals in the 2nd, 3rd, and 4th quartiles of carbohydrate intake had on average BMI of 0.018, 0.021, 0.030 % higher respectively compared to the individuals in the 1st quartile; p_{trend} 0.003. The individuals in the 2nd, 3rd, and 4th quartiles of fat intake had on average BMI of 0.016, 0.022, 0.024 % higher respectively compared to the individuals in the 1st quartile; p_{trend} 0.039. BMI increased with dietary glycemic load. The individuals in the 2nd, 3rd, and 4th quartiles of dietary glycemic load had on average BMI of 0.003, 0.007, 0.018 % higher respectively compared to the individuals in the 1st quartile; p_{trend} 0.047. In all the cases, the effects of covariates including demographic factors, life-style factors, and family history data of diabetes, were adjusted. There were no significant associations between the dietary intake of protein and fiber with BMI. In conclusion, a higher intake of carbohydrate, fat, and glycemic load was associated with a higher BMI in patients with newly diagnosed T2DM.

Keywords: *Body mass index, dietary intake, glycemic load, type 2 diabetes mellitus*

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Serum Vitamin D Concentration and Body Composition among Patients with CKD; A Hospital-Based Comparative Study

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Micronutrient deficiencies, muscle wasting and low bone mass are frequently manifested in patients with chronic kidney disease (CKD). Studies conducted in this area among Sri Lankans with CKD are scarce. A comparative study was conducted to compare the serum vitamin D concentration and body composition parameters between patients with CKD and control subjects. Fifty patients (38 men) with CKD awaiting kidney transplant at Teaching Hospitals, Karapitiya or Kandy, and a group of healthy age and sex-matched controls (n=50) were included in the study. Serum 25-hydroxyvitamin D (Vit. D) was estimated using ELISA technique. Body composition was measured using dual-energy x-ray absorptiometry scan. Data were analyzed statistically using unpaired T test and ANOVA were used to compare the two groups. Ethical approval was obtained from Ethics review committee, Faculty of Medicine, University of Ruhuna. Median (interquartile range) vit. D concentration was significantly lower among patients with CKD compared to controls (17.4 (24.3), 27.7 (22.95) ng/mL) ($p=0.001$). Mean (SD) total body lean mass (TBLM) ($p=0.026$), total body bone mineral content (TBBMC) ($p=0.041$) and total body bone mineral density (TBBMD) ($p=0.021$) were significantly lower among patients with CKD ((TBLM) (38993.5 (7197.5) g), (TBBMC) (1914.3 (394.0) g), (TBBMD) (1.06 (0.12) g/cm²)) compared to controls (TBLM (42540.0 (8131.6) g), (TBBMC) (2069.1 (337.1) g), (TBBMD) (1.10 (0.10) g/cm²)). Total body fat mass (TBFM) and truncal fat mass (TRFM) were not significantly different between the groups. Compared to age and sex matched controls, patients with CKD showed significantly lower serum Vit. D concentration, TBLM, TBBMC and TBBMD. Nutritional and therapeutic interventions are required to maintain the musculoskeletal health of CKD patients.

Keywords: Chronic kidney disease, total body bone mineral content, total body bone mineral density, total body lean mass, vitamin D

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ABSTRACTS OF FLASH PRESENTATIONS

Empowering Mothers to Improve Nutrition Status of under Five-year Children in a Selected Rural Village in Anuradhapura District using Health Promotion Approach

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Adequate nutrition during the early years of a child's life is important for their later health and development. In Sri Lanka, 17.3% of children under five are stunted, 15.1% of them are wasted and 2% are overweight. Therefore, it's important to empower mothers to improve the nutrition status of their children. This study aimed to determine whether mothers are empowered to provide age-appropriate nutritious diets for their children after the interventions. The intervention was carried out for 2 years with 25 mothers who have under five year children in Kurundankulama village. Group discussions were conducted with mothers to identify determinants for the inability to provide a well-nourished food intake for their children. High junk food consumption, low willingness of the child to eat nutritious food, poor knowledge of mothers on child nutrition were identified as main determinants. Knowledge on the importance of giving age-appropriate nutritious diets for their children during early childhood was provided to mothers. As possible actions to address above determinants mothers started collective feeding sessions as groups, managed child's junk food consumption and used different strategies like preparing vegetables with different colors, shapes and trying different aged specific food recipes to increase children's interest towards "Thripasha" and other nutritional foods. In the end, changes were assessed qualitatively through focus group discussions and data were analyzed using thematic analysis. Results indicated that all the mothers had improved their knowledge of the child's nutrition. 91% (n=22) of participants claimed their child's increment of nutritious food consumption, 82% (n=22) of mothers claimed that child's junk food consumption has reduced. 77% (n=22) of mothers identified that their child's age-appropriate weight gain has increased throughout the interventional period. According to the findings, health promotion can be conclude as an effective approach to address nutrition problems at community setting by addressing selected determinants.

Keywords: *Age-appropriate nutritious diets, child Nutrition, empowerment, health promotion*

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Effectiveness of Health Promotion Intervention to Reduce the Overweight among Over 30 Years old Women in Karuwalagashinna Village using Health Promotion Principles.

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Non communicable diseases (NCDs) are leading to 75% of total deaths in Sri Lanka. NCDs are caused by tobacco use, unhealthy diet excess use of alcohol and physical inactivity. The Aim of this collaborative quantitative research study was to evaluate the effectiveness of health promotion intervention to reduce overweight among over 30 years' old women in Karuwalagashinna semi-urban village in Mihintale MOH area in Anuradhapura district. Self-administrative questionnaires and focus group discussions were used as data collection techniques to collect data from 32 study participants. Overweight is identified as a major health issue among them by discussions and measuring their BMI through developing mothers' groups that have developed by themselves. Then they have prioritized the most influential determinants according to their necessity and preference to change in considerable time period. They empowered for planning community-based interventions to address prioritized determinants with their daily routine. At baseline, there were 9.67% in underweight, 19.3% in normal weight and 70.96% in overweight among the study participants. They developed oil meter, measuring cups for measuring their daily sugar, salt and oil consumption while empowered for engaging in physical activities. Study participants maintained BMI card for marking their BMI in monthly. They have been empowered to develop indicators for monitoring their progress in a collaborative way with their peer mothers. Through the above interventions, they reduced their overweight from 70.96% to 44.8% while other study participants reduced their weight more than their baseline measurement. Empowering the general community for addressing their determinants on such health issues using health promotion principles is effective for reduce risk and prevalence of health issues. It is effective way for improving knowledge and change attitudes and practices on NCDs assigned with the community.

Keywords: *Determinants, empowerment, health promotion principle, overweight, NCDs*

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Evaluation of Fat Content and Fatty Acid Profile of Selected Bakery Products Available in Jaffna District, Sri Lanka

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Bakery products play a vital role in the daily diet of most Sri Lankans. Solid fats used in bakery products contain a significant quantity of saturated fatty acids (SFAs) and industrially produced *trans* fatty acids (TFAs), which are associated with many human ailments. This study was aimed to determine the total fat content and fatty acid profile of selected bakery products available in the Jaffna district. Samples such as bread (n=17), bun (n=17), cake (n=16), pastry (n=12), doughnut (n=4) and bakery fats (n=5) were randomly collected from bakeries. The fat was extracted from samples using the Goldfisch method using petroleum ether and the fatty acid profile was analyzed using gas chromatography. All experiments were carried out in triplicates. The highest percentage of total fat was detected in pastry (21.63% - 39.83%) and doughnut (31.66% - 37.17%) followed by cake (17.40% - 30.00%), bun (3.30%-10.91%), and bread (1.00%-3.43%). The total SFA content of samples ranged from 46.15-85.34 g/100g of fat and the predominant SFA was palmitic acid. The mean SFA content as expressed in g/100 g of bread, bun, cake, pastry, and doughnut were 1.36, 3.57, 14.83, 17.25, and 17.06, respectively. All pastry samples and 17.64%, 47.05%, 37.5%, 50%, and 80% of bread, bun, cake, doughnut, and bakery fats, respectively contained TFAs. Elaidic acid (C18:1) and linolelaidic acid (C18:2) were detected as the TFAs in the bakery products, whereas bakery fats contained elaidic acid (C18:1) (1.07% - 4.89%) as the TFA. The ranges of TFA content of bread, bun, cake, pastry, and doughnut as expressed in g/100g of serving were 0.08, 0.28, 1.03, 2.47, and 1.54, respectively. In conclusion, except for bread, a significant proportion of all other bakery products consisted relatively high amount of SFAs and TFAs based on the recommendation by the World Health Organization (intake of SFAs and TFAs should be less than 10% and 1% of total energy intake, respectively).

Keywords: Bakery products, gas chromatography, saturated fatty acids, trans fatty acids

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Status of Pulses Consumption and Gaps Towards Promotion in Sri Lanka; an Online Survey

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Promoting healthy diets among general public is essential to mitigate the prevailing issues of diet-related diseases in Sri Lanka. Pulses are recognized as pivotal components of healthy dietary pattern. An online survey was conducted to determine the levels of knowledge, attitudes, behaviour (KAB) on pulses consumption and associated barriers towards adequate intake. A questionnaire was developed, pre-tested and dispersed via social media for data collection. Study population was female adults living in Sri Lanka and it was assumed that they were responsible for food behaviour of the entire household. The responses (n=416) collected were cleaned, coded and used in the analysis using SPSS, AMOS and descriptive statistics. Construct validity of the questionnaire was tested by a Factor Analysis. The questionnaire consisted of 6 categories as 4 behaviour categories, a knowledge category and an attitude category. The resulted model of the questionnaire exhibited appropriate model fit in AMOS. (C min/df= 3.265, RMSEA= 0.074, CFI= 0.709). A 47% of the population showed good attitude scores whereas 49% and 50%, showed low knowledge and behaviour scores, respectively. The major consumption barriers of pulses included lack of knowledge on specific health benefits of pulses intake, unacceptable organoleptic properties, the need of longer preparation time, high price, rejection of consumption by family members, same recipe with similar tastes and gastric disturbances after consumption. Significant correlations (p<0.05) suggested education level, family income and province of residence effects on behaviour regarding pulses consumption. Education level affected on knowledge. Thus, educating the general public, addressing the price issues, introducing innovative recipes and cooking methods to minimize gastric disturbances, and popularizing commercial convenient products are required to uplift the pulses consumption among Sri Lankans.

Keywords: Attitudes, behavior, female adults, knowledge

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Factors Associated with Nutritional Adequacy of Advanced Level Students in Colombo District

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Poor eating habits, the abundance of unhealthy food and insufficient awareness of nutrition are associated with development of non-communicable diseases (NCD). Adolescents, transitional phase of growth and development between childhood and adulthood are in higher priority to consume a nutritionally balanced diet to reduce the possible risk of NCD. The objective is to identify factors associated with the nutritional adequacy of Advanced level students in Colombo district schools. A descriptive, cross-sectional study, using convenient sampling technique, was conducted, among 480 Advanced level students by a self-administered questionnaire, using Google forms, from September 2020 to June 2021. The form was shared among social media groups and the dietary intake data of the student sample was tabulated using the outcome. The mean value of the general well-being score was calculated. The Dietary Diversity was evaluated using three days dietary recall and the food groups were selected from the Food-Based Dietary Guidelines (FBDG), Sri Lanka. Nutritional adequacy was defined as consumption of ≥ 4 from the six main food groups in the food pyramid in FBDG. Analysis was done using SPSS 26th version and the associations were obtained using Chi square test and independent t test. Results of the study data showed the majority of female students 52.6% (n = 171) were taking a nutritionally adequate diet compared to males (46.7%, n = 70). A more nutritionally adequate diet was consumed by students with high family income (53.1%) compared to middle (51%) and low (46.7%) income groups. Breakfast was the mostly skipped meal (n=222,46.6%). There was a statistically significant association between skipping breakfast and lunch with the monthly income of the family (p < 0.05). Meal skipping is more common among low-income group (breakfast = 57.5%, lunch = 45.3%) than middle and high incomers and the association was statistically significant (p < 0.05). Students following biological science stream (56.1%, n = 110) were having a more nutritionally adequate diet compared to others. The mean value of general well-being score was higher (76.4) with nutritional adequacy of diet, compared to inadequate group (70.2) indicating a statistically significant association. There was no association between Body Mass Index (BMI) and nutritional adequacy of the diet. There was a statistically significant association (p<0.05) of skipping breakfast and lunch with the monthly income level and between nutritional adequacy of diet and general well-being score. Nutritional adequacy of students showed statistically insignificant associations with gender, subject stream, income and BMI.

Keywords: Adolescents, diet, non-communicable diseases, nutritional adequacy

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The Design and Development of Glycemic Index (GI) Based Electronic Database Management System

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Systematic tabulation of Glycemic index (GI) and Glycemic Load (GL) tables is not widely available. It is an important requirement since every country has a cuisine style comprise of several locally produced foods. The aim of this research is to develop a GI-based electronic database management system that can be benefited both consumers and researchers. The database management system was coded with multiple programming languages including Java 8.0 and SQL (Structured Query Language). NetBeans 12.2 was used as an integrated development environment for Java. Microsoft SQL Server was used as a relational database management system that supports several applications of the developed database. This database was developed in three phases; phase 1 was the systematic tabulation of GI data entries for local foods from verified published sources. Phase 2 was the development of consumer interface of the database in which contains GI-based information about the food, as well as its GL (if available) and nutritive value. In this database, the consumer can perform a search of GI of the food in either Sinhala or English. Phase 3 was the development of a researcher interface in where researchers can access previously published GI information and ISO 26642 guidelines for conducting the GI-based *in vivo* experiments. Moreover, the database also consists of researcher-friendly custom-built software to calculate the area under the curve of the blood glucose response and thereby obtain the GI and GL. Additionally, a researcher can update the database with the findings of GI for Sri Lankan foods while retaining ownership. This E-database management system based on GI and GL of commonly consumed Sri Lankan foods not only improves the quality and quantity of GI data available for research and clinical practice but also facilitates the promotion of healthier food habits within the general population.

Keywords: *Database, glycemic index*

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Trans Fat Content of Selected Foods Commercially Available for sale in Kandy District

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The relationship between the consumption of *trans* fat and increased risk of coronary heart diseases, cancer, diabetes mellitus among others is well established. The sources of *trans* fat include foods produced using partially hydrogenated oils, fried snacks and baked goods. Fried and baked foods available at eateries, restaurants and sold by roadside vendors are popular among Sri Lankans of all ages. Deep frying is a culinary operation widely used by restaurants, street vendors, confectioners, bakers as well as at domestic level. Furthermore, the reuse of frying oils also contributes to the generation of *trans* fats. The present study was carried out to quantify the *trans* fat level of selected processed foods collected from Kandy district. A total of 30 food samples were collected from bakery chains, restaurants, grocery stores and small food outlets in Kandy district representing all ethnicities and dietary variations. The fat was extracted from composite samples. The extracted oil samples were methylated and analyzed for the total fat, saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), unsaturated fatty acids (UFA) and *trans* fatty acid (TFA) contents of samples were determined using gas liquid chromatography (GLC). *Trans* fat content ranged from 0.00 – 1.50 g/100 g in food samples tested. The highest *trans* fat content was observed in chilli paste samples while the other food items tested contained <1 g / 100 g. Elaidic acid (C18:1t) and linolelaidic acid (C18:2t) are the main two *trans* fatty acids detected in the foods tested. Of the two *trans* fatty acids, elaidic acid was the predominant *trans* fatty acids detected in foods tested.

Keywords: *Monounsaturated fatty acids, polyunsaturated fatty acids, saturated fatty acids, total fat, trans fat*

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Production of Green Banana Powder Sauce from *Ambul* and *Puwalu* Varieties and Evaluate their Physicochemical, Antioxidant Properties and Shelf Life

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The goal of this research was to make green banana sauce from *Ambul* and *Puwalu* banana varieties harvested in *Kilinochchi*, Sri Lanka, and to evaluate their antioxidant properties (total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacity), proximate composition and shelf life. The green banana powder was prepared from the peeled off fresh green banana, and then the sauce was developed according to SLS modification made to the SLS 581:2008. After several preliminary trials, the best four sauce formulations with control sauce were selected. The green chili sauce was prepared as the control sauce, and the green chili paste was added as a coloring agent for green banana sauce due to the color resemblance with green chili sauce. The 15 g of *Ambul* green banana powder sauce demonstrated the highest sensorial features followed by 10 g *Puwalu* sauce; 250 g sauce was made from this powder formulation. Overall, the proximate composition of the selected two sauces was higher than the control sauce on a fresh weight basis. Among, the crude protein (4.37-5.03%), crude fiber (24.34-23.35%) and ash content (2.2-2.64%) were significantly ($p < 0.05$) higher than the control sauce (Crude protein-1.24%, crude fiber-6.75% and ash – 1.27%). Extraction was carried out with 70% (v/v) ethanol to determine the antioxidant properties. The TPC (0.09 mg of Gallic acid equivalent/ g dry matter) and antioxidant capacity (0.115 mg of Catechin equivalent/ g dry matter,) were high in the *Puwalu* sauce than *Ambul* sauce (TPC- 0.057 mg of Gallic acid equivalent/ g dry matter, and antioxidant capacity- 0.113 mg of Catechin equivalent/g dry matter,). However, the TFC was significantly ($p < 0.05$) higher in the *Ambul* sauce (0.152 mg of Ascorbic acid equivalent/g dry matter) than *Puwalu* sauce (0.101 mg of Ascorbic acid equivalent/g dry matter). For shelf-life analysis, after one and two months of storage, both sauce samples reported total plate count was lesser than 10 (2-2.5), when compared with the control sauce, the count was 3.2-3.3. As a result, *Ambul* and *Puwalu* green banana varieties could be used to make the sauce with profound health benefits.

Keywords – *Ambul* and *Puwalu* banana, antioxidant properties, green banana powder, sauce

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***In Vitro* Antidiabetic Effect and Antioxidant Potential of *Averrhoa carambola* (Star Fruit)**

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Diabetes is a global health concern with millions of incidences and mortalities reported annually. Antioxidants indirectly reduce the risk of diabetes by neutralizing reactive oxygen species. To reduce the prevalence and lower premature mortalities, global focus is shifting towards natural remedies which are nutritional, accessible, and cost-effective. The objective of this study was to analyse the potential antidiabetic and antioxidant properties of *Averrhoa carambola* and compare the two biochemical properties in different plant parts of *A. carambola*. Fruits, leaves and flowers were collected from two different ecological zones in the Western Province of Sri Lanka; Horana and Katunayake. Soil type, temperature, the humidity of the collection sites were measured. Crude extract of fruit (juice) following filtration of the homogenized samples and methanolic extracts of fruit pulp, flowers and leaves were obtained following sample drying, maceration and distillation. Samples were assessed for hypoglycaemic activity and antioxidant activity by using glucose adsorption and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assays respectively in duplicates. Significant differences between sample types, sample concentrations and correlations were assessed using Kruskal-Wallis, Dunn's, Pearson's and Spearman's correlation statistical analyses. A significantly higher antioxidant activity ($p < 0.05$) was observed in fruit juice compared to fruit pulp extract while antioxidant activity in other samples was not significantly different. Similarly, antioxidant activity of the fruit juice was not significantly different from ascorbic acid ($p > 0.05$). Overall, a very strong positive correlation ($\rho = 0.83, p < 0.01$) was observed between the percentage antioxidant activity and sample concentrations (fruit juice, fruit pulp, leaf, flowers). A strong positive correlation ($r = 0.68, p < 0.01$) was observed between bound glucose and sample concentrations. Samples from Horana had the strongest positive correlation for hypoglycaemic activity ($r = 0.65, p < 0.01$) and antioxidant activity ($\rho = 0.85, p < 0.01$). Due to combined antidiabetic and antioxidant activity shown by fruit, leaf and flower extracts of *A. carambola*, it has the potential to serve as a nutraceutical for diabetes.

Keywords: *Antioxidant, Averrhoa carambola, diabetes, hypoglycaemic activity, nutraceutical*

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Anthropometric Assessment of Nutritional Status and Associated Metabolic Syndrome Risk Factors Among Rural Indian Adults

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Metabolic Syndrome (MetS) is a group of conditions that increases the risk of heart disease, stroke, diabetes and major causes of death and disability in south Asian countries. The study was aimed to find out the association of nutrition status and risk factors of MetS among rural adults of India. This cross-sectional study was carried out among 469 rural adults, aged 30 to 60 years in West Bengal, India. Anthropometric measurements, such as stature, body weight, circumferences at mid-arm (MUAC), minimum waist (MWC) and maximum hip (MHC) and four major skinfolds at biceps (BSF), triceps (TSF), sub scapular (SSSF) and supra iliac (SISF) regions were measured. Body Mass Index (BMI) and Waist-Hip Ratio (WHR) were calculated using a standard formula. Systolic (SBP) & Diastolic (DBP) blood pressures and fasting blood glucose were measured from each participant. A questionnaire was used to collect data on the socioeconomic profile, physical activity and family history of MetS. The weekly consumption of food was collected using a food frequency questionnaire. The male participants had higher mean values of BMI and WHR, but no significant sex difference is observed for SBP and DBP. Mean values of blood glucose were higher among male participants. The prevalence of MetS was 43.9% (41.9% among females and 46.4% among males) among participants. The family history of hypertension and physical inactivity were found to be significant in association with blood glucose among the participants. The prevalence of elevated fasting blood glucose and raised blood pressure were 39.8% and 44.1%, respectively among participants. The family history of hypertension, physical inactivity and faulty food habits like extra intake of salt and low intake of fruits were found to be significant association with blood pressure and blood glucose among the participants. The study revealed that the prevalence of MetS and other diet-related risk factors like overweight & obesity were high among rural participants of studied area. The cardiovascular morbidity and mortality will be enormous in later life of the participants, if these trends continue. Prevention should begin during early ages in life, when a modification in lifestyle can reduce diet-related risk of MetS, so that they do not become the epidemics of the 21st century.

Keywords: Adults, Indians, metabolic syndrome, nutritional status, rural.

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Empowering a group of Women to Improve Their Decision Making Ability on their Dietary Practices in Sinna Pullchchi Potkerny, Mannar district, Sri Lanka, using the Health Promotion Approach

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Non-Communicable Diseases (NCD) account for 75% of all deaths in Sri Lanka, which can be prevented to a great extent by simple community-based interventions. There has been an increase of NCDs in the Northern Province of Sri Lanka due to rapid urbanization and lifestyle transformation. This study aims to empower a selected group of women on improving decision-making skills of their dietary patterns. This study was conducted with 50 women aged ≥ 25 years selected by purposive sampling method. The process was initiated with small groups of women based on Health Promotion principles. Nutrition targets were decided mutually with them and refined further by the facilitator. They were capacitated to identify and prioritized the determinants of their poor dietary patterns. Through focus group discussions prioritized determinants were addressed through planned community -based interventions developed with them. Progress monitoring was done by women themselves using indicators developed with the facilitator. Quantitative and qualitative data were analyzed using descriptive and thematic analyses, respectively. More than 90% of study participants selected “poor money management” and “poor decision making in diet behavior” as prioritized determinants of their diet choices. 40% of participants developed a chart that shows the decisions made by family members when purchasing food and “till box” to save the left over money from avoiding unnecessary expenses to address the above determinants. As a result of these interventions, 20% of individuals reduced consuming junk foods and increased their intake of homemade food. Also, 30% of the study participants consumed more organic vegetables and fruits than they did eight months ago. The study population became aware of the nutritional value of foods, preservatives added in foods and commercial influences when purchasing foods. The health promotion approach effectively empowers lay communities to develop better dietary practices through improved decision making.

Keywords: *Determinant, health promotion, non-communicable disease, nutrition, poor decision-making skill*

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Using Health Promotion Approach for Empowering Families to Address the Selected Determinants of Non-Communicable Diseases during the COVID-19 Pandemic

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Non-Communicable Diseases (NCDs), presently become a major threat to the health and wellbeing of people worldwide with the COVID-19 pandemic. Therefore it is important to empower the community to reduce the risk for NCDs. This study was aimed to empower the community for identifying the determinants of NCDs and addressing selected determinants at the family level using the health promotion approach. The study was carried out for 6 months with 12 families in a semi-urban area. A discussion on NCDs risk with the COVID-19 pandemic was initiated and determinants for NCDs were identified through several focus group discussions. Unhealthy dietary practices and lack of exercise were the determinants prioritized by the community based on the criteria; willingness, easiness to change and lesser time is taken to detect the changes. Then they were guided to design activities to address the prioritized determinants. During the pandemic period, the process was followed up and monitored through phone calls. The changes were analyzed using descriptive statistics and thematic analysis. The activities they implemented included, changing their food plate, spoons to reduce the excessive amount of rice that they eat, changing container bottles of sugar, salt and oil into small ones and marking a scale on the oil bottle. They engaged in home gardening and increased the time spent on daily exercises. They marked their changes on the 'happy kitchen calendar' using happy moods. According to the analyzed results of the 'happy kitchen calendar', all 12 families have reduced the consumption of sugar, salt and oil by 58%, 66%, and 56% respectively. With home gardening, exercising hours also have been increased. As qualitative changes, they have improved their knowledge and attitudes regarding the reduction of NCD risk. Based on the results, it can be concluded that the health promotion approach was successful in addressing the selected determinants of NCDs.

Keywords: *COVID-19 pandemic, health promotion, non- communicable diseases*

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Engaging Selected Families to Identify the Determinants of Unhealthy Dietary Practices that Increase the Risk of NCDs in Kalalgoda area, Colombo District using the Health Promotion Approach.

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The mortality of NCDs is 41 million people each year that is equivalent to 71% of all deaths globally. In the Sri Lankan context, NCDs is the leading cause of premature deaths. And the mortality of NCDs is nearly 82%. Healthy dietary practices play a major role to reduce the risk of Non-Communicable Diseases (NCDs). The objective is to identify the determinants of unhealthy dietary practices that elevate the risk of NCDs among selected families of Kalalgoda village in the Colombo district. This was a qualitative study conducted with 20 persons in the 30 - 65 age groups in 10 families. Initially, the group discussions were conducted with the participants on the topics of causation for NCDs and unhealthy dietary practices among them. Informal discussions, focus group discussions and non-participatory observations were used to initiate a process with them. Waist Circumferences were measured as base-line data using measuring tools. Study participants were guided to identify determinants in 10 group discussions where each discussion was for around 15-20 minutes. Determinants were identified by the study participants by drawing a determinant web. They analyzed the determinants and prioritized to address based on the possibility and importance of changing. Data were analyzed thematically. Some of the measured base-line values of waist circumferences were 91 cm, 78.5 cm, 82 cm, 85 cm. The study group could identify 10 visible and hidden determinants and links among the determinants. Peer influences, media influence, addiction to soft drinks, higher usage of processed and instant foods were the prioritized determinants. Throughout the process they have changed their negative attitudes on unhealthy dietary practices, increased their understanding about E-numbers & detrimental effects of using instant food and improved their level of awareness on media strategies and promotions.

Keywords: *Determinants, dietary practices, health promotion approach, non-communicable diseases*

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Development of Database Management System for the Tabulation of Nutritional and Sensory Quality and Safety-related Information of Culinary Products Used in the Cinnamon Hotels and Resorts

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Well-established large-scale foodservice industries utilize around 2000-3000 different types of food ingredients daily to cater to the demand of their customers. In the catering industry, new food packages are opened daily to prepare food cuisines and the remaining part of the food ingredient is stored to utilize it later. Thus, there is a possibility to arise food ingredient-related quality and safety issues after pack opening which are mainly related to the biochemical changes and its exposure to spoilage and pathogenic microorganisms. The nutritional quality of the food is also affected during food deterioration. Thus, this research aimed to systematically tabulate the shelf-life, secondary shelf-life, storage conditions to preserve the sensory and nutritional quality of the food, modes of spoilage, and allergenicity information of food ingredients that are used in Cinnamon Hotels and Resorts. Cinnamon Hotels and Resorts is a leading Sri Lankan foodservice industry that manages 15 four-star and five-star hotels across Sri Lanka and the Maldives. The research was partially based on information accumulated from the research of published international and industry data sources and the other part was based on pro-active experience and inputs from chefs and key stakeholders who are engaged in the food quality and safety aspects of Cinnamon Hotels and Resorts. The research results comprise of a guidebook (ISBN 9786245887002) and a custom-build electronic database. Both the guidebook and the electronic database assist to give a realistic guide of handling food ingredients for the chefs within the catering sector. This research concludes with the overall summary of information for each food category, which provides convenience for use this guidebook/software for the chefs. The outcome of the research generated a standardized procedure among the chefs to manage the storage of culinary products and to preserve their nutritional and sensory quality.

Keywords: *Cinnamon Hotels and Resorts, food service industry, perishability, secondary shelf-life, spoilage*

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Assessment of Nutritional Composition and Functional Properties of Arrowroot and Artichoke flour

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Roots and tuber crops are prominent sources of edible carbohydrates with the ability to grow in diverse soil and environmental conditions with minimum agricultural inputs. The purpose of this study was to investigate the nutritional composition and functional properties of crude flour prepared by two underutilized tuber crops available in Sri Lanka; Arrowroot and Artichoke. Mature undamaged fresh tubers were selected using a random sampling method, cleaned, peeled and cut into thin slices. The slices were dried in an electric convection oven, ground into flour using an electric grinder, sieved through a 60 mesh screen and stored in air-tight glass containers. The proximate results were expressed on a dry weight basis. According to the study, Arrowroot and Artichoke powders were found to be rich in carbohydrates ($79.05 \pm 0.21\%$ and $75.64 \pm 0.14\%$ respectively) and crude protein, where Artichoke showed a significantly higher value for crude protein content ($11.79 \pm 0.04\%$). The crude fat contents of Arrowroot and Artichoke ($0.44 \pm 0.03\%$ and $0.46 \pm 0.01\%$ respectively) were considerably low. The ash content was higher in Artichoke flour ($4.15 \pm 0.15\%$) with no significant difference with Arrowroot flour ($P < 0.05$). The crude fibre contents were reported as $0.89 \pm 0.02\%$ and $1.22 \pm 0.02\%$, where Arrowroot was found to contain a higher crude fibre level. Potassium, Magnesium and Calcium were present in significant quantities and Iron and Zinc were present in considerable levels in both varieties. Arrowroot flour had the highest water holding capacity ($149.40 \pm 1.98\%$), water solubility ($2.61 \pm 0.04\%$) and emulsion activity ($26.25 \pm 2.83\%$) while Artichoke flour observed the highest values for oil holding capacity ($110.30 \pm 2.39\%$) and water absorption index (2.52 ± 0.12 g water/ g powder). Palmitic acid and Linoleic acid were predominant in both selected tubers while a high level of oleic acid was observed in Artichoke flour (18.58 g/100 g total fatty acids). Hence, the selected underutilized root and tuber crops exist great nutritional potential.

Keywords: Arrowroot, artichoke, functional properties, nutritional composition.

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Spontaneously Fermented Buffalo Curd as a Natural Functional Food with *Lactobacillus acidophilus* having Probiotic & Antagonistic Properties

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Certain functional foods are reservoirs of natural probiotic bacteria which process certain health benefits. Naturally containing probiotic bacteria must bear specific characteristics. Antagonistic activity against other microorganisms by producing antimicrobial substances is one such character. Spontaneously fermented buffalo curd devoid of industrial starter cultures is a natural reservoir of indigenous *Lactobacillus* species. This study investigated *in-vitro* antifungal activity of indigenous *Lactobacillus acidophilus* (k1) strain isolated from spontaneously fermented buffalo milk, against food spoilage *Aspergillus* spp. and *Penicillium citrinum* isolated from pasteurized fruit syrups. *L. acidophilus* (k1), *A. foetidus*, *A. flavus*, *A. oryzae*, *A. elegans* and *P. citrinum* were isolated and molecular biologically identified by the authors, previously. *L. acidophilus* (k1) was streaked as a single line in pre-solidified modified MRS agar plate and incubated anaerobically at 37°C for 48h. A fungal agar block (1 cm x 1 cm) was placed on center of the incubated MRS agar plate maintaining considerable distance from the *L. acidophilus* (k1) streak and incubated aerobically at 28°C up to 7 days. Up to 7 days, the area of each growing fungal mycelium against *L. acidophilus* (k1) were measured by square pixels in photographs and square pixels then converted to square centimeters. Ability of antifungal activity on each fungus was detected by the growth area of each fungal mycelium compared with the control sample of same fungus at same time. *L. acidophilus* (k1) reveals 94%, 74%, 48%, 44% and 27% reduction in *A. elegans*, *A. foetidus*, *A. oryzae*, *A. flavus* and *P. citrinum*. As *L. acidophilus* (k1) has shown promising positive antifungal effect against all tested fungal species, reveals that the indigenous *L. acidophilus* (k1) processes potential probiotic ability. Based on this evidence, spontaneously fermented buffalo curd can be categorized as a natural functional food that contains live *L. acidophilus* with probiotic antagonistic activity.

Keywords: Antagonistic effect, *Aspergillus* spp., functional foods, *Lactobacillus acidophilus*, probiotics

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Dietary Diversity, Its Determinants, and Association with Malnutrition: Analysis across the Children in the Resettlement Areas in Jaffna District

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Nutritional status is one of the most important indicators of the quality of life in children. Child under five years is among the most vulnerable to nutritional deficiencies. Prevalence of child undernutrition is higher among the resettled, compared to the resident group in Jaffna. A single food item cannot fulfill all nutrient requirements of the individual. Eating a wide variety of food is likely to increase nutrition adequacy. Thus, a study was conducted to measure the individual dietary diversity and nutritional status of children and to explore the determinants of dietary diversity and its association with child malnutrition in the resettlement areas. A cross-sectional survey was carried out in the *Valikamam* North region of Jaffna district involving 60 children (6-59 months) with their mothers or caregivers as respondents. A multistage random sampling procedure was used to select the sample to eliminate systematic bias. Dietary diversity was measured using dietary diversity scores. Dietary diversity scores ≤ 4 , 4-8, and >8 fell in the low, medium and high dietary diversity categories respectively. Stunting, wasting, and underweight children were identified using WHO child growth standard charts. Multinomial logistic regression and Chi-square analyses were used to analyze the collected data. Descriptive analysis revealed that the children consumed 2 to 9 food groups out of 12 food groups over 24 hours. The consumption of animal products such as milk, meat, eggs was low compared to plant-based products. The majority of the children (71.1%) consumed a diet that was in the medium dietary diversity category. Multinomial logistic results showed that the sex of household head, maternal education, and caregiver's age have a positive, significant effect on dietary diversity ($P < 0.05$) while cultural food taboos have a negative, significant effect on dietary diversity ($P < 0.01$). The prevalence of stunting, underweight, and wasting in the study sample was respectively 38.34%, 25%, and 8.34%. As per the results of the Chi-square test, there was no association between dietary diversity and malnutrition status of children in the study area. Government intervention, unavailability of safe water, and improper sanitation are associated with the malnutrition status of children. Thus, the study recommends having new policies or programs which target improving the knowledge of mothers and availability of safe water and sanitation in the area to improve the nutritional status of children.

Keywords: *Dietary diversity, malnutrition status, resettlement area, stunting, wasting and underweight*

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Development of an Information Resource of Drug-Nutrient Interactions to Healthcare Professionals for facilitating Management of Drug-Nutrient Interactions

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Awareness of healthcare professionals (HCPs) about interactions between drugs and food or drugs and nutrients is important to improve patients' health and prevent adverse effects associated with those interactions. However, easy access to information about drug-nutrient interactions (DNIs) is not always available. By considering the necessity of updated information on potential DNIs with dietitians and other HCPs to optimize patients' health, a guide booklet on DNIs for HCPs was created through this study. The first step of the study was to gather available information on DNIs by reviewing the literature and referring drug-related institutional publications in previous 15 years. Secondly, a preliminary survey was conducted among conveniently selected 30 HCPs including doctors, dietitians, pharmacists and 10 adults by using an interviewer administered questionnaire to assess the awareness on DNIs with the view of collecting their experiences and practices on DNIs. Thirdly developed a guide-booklet by compiling all collected information on potential DNIs. Finally, the content validity of the developed booklet was done by doctors, dietitians and pharmacists via an online questionnaire to confirm the adequacy of information, user-friendliness and the appearance of the booklet. Around 145 potential DNIs discovered/gathered across 95 different drugs or drug categories. The majority of identified DNIs are for the drugs taken to cardiovascular diseases, gastrointestinal disorders and infectious diseases. Findings of the preliminary survey showed that 90% of studied HCPs considered DNIs to manage such interactions while 70% of adults had heard or had experience of DNIs. Although 90% of HCPs considered DNIs when providing services only 83% had given advice to patients regarding how to manage such interactions. Further, the findings of the survey confirmed that lack of information sources was the major barrier of HCPs for managing DNIs. All Collected information on potential DNIs was compiled as a coloured, pictorial, A5 sized booklet and DNIs were presented in a tabular form under different diseases. Potential drug-nutrient interactions, their effects, possible prevention strategies and risk factors were also included in tables. The developed simple, user-friendly and updated DNIs information included guide-booklet will be a helpful source of information for HCPs in management of DNIs and for adults in prevention from DNIs.

Keywords: *Drug-nutrient interactions, food-drug interactions, guide booklet*

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Comparison of Proximate and Antioxidant Properties of the Developed Herbal Biscuits

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Biscuit is a common baked snack in Sri Lanka. This study was aimed to develop a herbal biscuit by incorporating the herbal mixer which was made with coriander (*Coriandrum sativum*), cinnamon (*Cinnamomum zeylanicum*), curry leaves (*Murraya koenigii*), ginger (*Zingiber officinale*), and licorice (*Glycyrrhiza glabra*), and to analyze the antioxidant and nutritional properties of the accepted biscuits along with the control sample to find out the most suitable compositions for commercialization. The herbal mixer was selected based on the therapeutic and nutritional characteristics of these herbs and the safe consumption level. Two treatment mixer of herbs were prepared and T1 (T1: 22.73:22.73:22.73:22.73:9.09) was accepted from sensory evaluation. The accepted biscuit was fortified with 10g of the herbal mixer, whereas the control biscuit was not fortified. Statistical analysis of the study was carried out using ANOVA SAS university edition. The results of proximate and antioxidant analysis for control and accepted biscuit respectively were moisture (2.08%, 3.06%), ash (1.43%, 1.84%), crude fiber (1.34%, 3.15%), crude protein (11.82%, 12.41%), crude fat (18.37%, 15.29%), TPC(0.64mg and 1.19mg GAE/g dry weight), TFC (0.22mg and 0.67mg CE/g dry weight) and antioxidant capacity (3.49mg and 5.04mg AAE/g dry weight). When compared to ascorbic acid standard, the DPPH scavenging activity of accepted biscuit was higher (0.265mg/ml) than the control biscuit (0.879mg/ml) by IC₅₀ value. According to the above results, biscuits fortified with herbs have higher nutritional and antioxidant properties than control biscuits, indicating that the herbs increase the nutrient value of the biscuits.

Keywords: Antioxidants, biscuits, fortification, herbs

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Improving Healthy Food Practices within Families during COVID 19 Pandemic Using Health Promotion Approach

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Family food practices play a major role in determining the well-being of its members. COVID-19 pandemic changed the everyday life of people and also it affected family food practices. The objective of this study was to improve healthy food practices within a group of families during the pandemic period. A health promotion intervention was implemented with voluntary participation of 21 members in Dolahena village in Gampaha district for six months using distant mode communication methods like WhatsApp and telephone calls. A discussion was initiated on family food practices during the pandemic period and whether their family food practices were healthy was discussed with them. Then determinants for unhealthy family food practices were identified. Family members having different food choices, preference for junk food, adding more sugar, salt and oil as a habit, eating a big portion, less availability of healthy food and neglecting the nutritional value were the identified determinants. Then activities to address the selected determinants were planned and implemented by the families. Preparing a balanced food menu for the family, measuring the amounts of sugar, salt, and oil, preparing snacks at home and increasing the variety of vegetables and fruits available in the gardens were some activities they have implemented. Interviewer- administered questionnaires were used at pre and post phases of the study to assess changes in their family food practices. Quantitative data were analyzed using descriptive statistics and comments of the participants were analyzed thematically. Results show that all five families have reduced monthly consumption amounts of sugar, salt and oil nearly by 50%, 66% and 20% respectively. All five families have consumed green leaves from their gardens at least three times a week and have improved the number of vegetables and fruits in their garden. The frequency of buying junk food has reduced nearly by 70%. 6 out of the 21 participants have changed their plate sizes. Family members' satisfactory level about the meal and perceived family relationships also have increased. According to the results, it can be concluded that this health promotion intervention carried out through distant mode communication is effective in improving healthy family food practices.

Keywords: *Balanced food menu, determinants, family food practices, health promotion, pandemic period*

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Development and Validation of a Tool to Measure Food Literacy of Adolescents in Sri Lanka

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Improving food literacy in adolescents helps to establish lifelong healthy dietary behaviours. Therefore, measuring the food literacy levels of adolescents would help to understand their current status and gaps in their food literacy. The objective of the present study was to develop a tool to assess the food literacy of 13-15 years-old school children in Sri Lanka. The tool was developed in two phases. The first phase involved identifying food literacy competencies through a literature review and generating items (questions) based on these competencies. In the first phase, an item pool consisting of 105 items was created under seven competencies (knowledge, skills and behaviours, food/health choices, culture, emotions, food systems, and eating). In the second phase, a brainstorming session was conducted with five nutrition academics to scrutinize the items, which were then narrowed down to 74. Next, the content validity (the degree of relevance and representativeness of items for the aimed assessment) was evaluated using an expert panel (n=11) consisting of 7 In-Service Advisors in education and 4 nutritionists. Based on the experts' comments, the Content Validity Index (CVI) and Content Validity Ratio (CVR) were calculated for each item, and items with CVI and CVR above 0.78 and 0.59, were selected for the tool. Next, the face validity (relevance of items as it appears to the target population) was checked by conducting two focus group discussions with grade 9 (n=8) and 10 students (n=6). Finally, a validated 47 item tool addressing seven competencies: knowledge (n=11), skills and behaviours (n=6), food/health choices (n=5), culture (n=8), emotions (n=5), food systems (n=6), and eating (n=6) was developed to assess the level of food literacy of a nationally representative sample of secondary school children.

Keywords: *Adolescents, competencies, food literacy, school, validity*

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Empowering a Rural Community to Identify and Address Determinants of Non-Communicable Diseases (NCDs) during Covid 19 Pandemic using the Health Promotion Approach

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People who have non-communicable diseases are more vulnerable to severe outcomes of Covid 19. The aim of the study was to describe the identifying and addressing determinants of non-communicable diseases during Covid 19 pandemic. A health promotion intervention was conducted among 30 families in Monaragala District. The overall study was carried out for 6 months. Initially improved their knowledge and shared success stories and introduced advantages of identifying determinants of NCDs to improve their enthusiasm. Then the participants were guided to identify the determinants of NCDs and they could prioritize high consumption of sugar, salt and oil as major determinants of NCDs. Distant mode communication methods were used to continue and assess the changes. The findings are analyzed using thematic analysis and descriptive statistics. Among them 70% (n=32) engaged in activities to reduce consumption of salt, oil and sugar like making “kitchen calendar”, allocate salt power spoons according to family members, using “oil meter”, using oil spray bottles, minimizing eating sweet products. All the participants improved the ability of identifying determinants of NCDs. According to mothers, most of them could reduce the junk food consumption from preparing food items using home gardening items, starting money collection method which they spent to buy junk foods. The chosen health promotion approach (through distant mode) to empower a rural community to address selected determinants of non-communicable diseases during pandemic situation was successful.

Keywords – Determinants, non communicable diseases

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Association Between Shift Work and Body Composition in Health Workers

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Shift work is considered necessary and indispensable to ensure the continuity of essential services. It is known to have an impact on body composition and related health problems. This study aimed to compare body composition parameters between shift-workers and non-shift workers employed in the health sector. A comparative cross-sectional study was carried out among female health workers aged ≥ 18 years at a large private hospital in Colombo. A sample of both shift and non-shift workers was recruited by stratified random sampling. All subjects underwent anthropometric measurements (height, weight, hip and waist circumference, skinfold thickness, mid arm circumference) and bio-impedentiometric analysis (BIA; Bodystat 1500) for body composition parameters. Skinfold thicknesses at 2 sites (biceps, triceps) were obtained using a Harpenden calliper. The independent t-test, chi-square test and logistic regression analysis were performed. This study consisted of 19 non-shift working and 21 shift working females. Mean ages (SD) of the non-shift and shift work groups were 38.4 ± 12.2 and 42.6 ± 11.9 years, respectively ($P=0.27$). The overall prevalence of obesity (≥ 25 kg/m²) and abdominal obesity (WC: ≥ 80 cm) was higher among shift workers (66.7%; 85.7%) compared to non-shift workers (26.3%; 73.7%). Shift working females had significantly higher mean body fat percentage (BF%), weight/height ratio and fat mass index (FMI) compared to non-shift working females ($p < 0.05$). When adjusted for age and work years, the odds ratios of having obesity (OR 5.35, 95% CI 1.15-24.93; $P=0.03$), abdominal obesity (OR 1.47, 95% CI 0.22-9.96; $P=0.69$), and elevated BF% ($\geq 40\%$) (OR 3.8, 95% CI 0.89-15.87; $P=0.07$) were higher among shift workers compared to non-shift workers. The overall prevalence of obesity, abdominal obesity and elevated BF% was higher among shift workers. Health interventions for shift workers need to be improved mainly focused on overall weight management.

Keywords: *Body composition, body fat, non-shift work, obesity, shift work*

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Empowering Selected Families of a Rural Community to Provide Proper Nutrition for Children; A Health Promotion Intervention

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Meeting proper nutritional requirements during childhood can impact better health and wellbeing of a child by reducing future health risks and morbidities. It is important to empower the families to provide proper nutrition for children. This intervention aimed to empower selected families to provide proper nutrition for children using health promotion approach. The intervention was carried out for 6 months with 33 families in 4 villages of a selected GN division. Online mode discussions were conducted and the importance of having proper nutrition during younger age was discussed. Main determinants of poor nutrition were identified. Those were high use of junk food and unwillingness of children to take nutritious foods. Success stories of health promotion interventions were shared to maintain the enthusiasm of the community and they were guided to design and implement activities to address the identified determinants. Data was collected through focus group discussions done in distance mode. Changes were analyzed through descriptive statistics and thematic analysis. To maintain continuous engagement, families were contacted via phone calls and zoom as feasible to them. Mothers reported that they started using fruits & vegetables instead of processed foods and milk powder consumption was reduced after the intervention. 87.9% (n=29) of families reduced junk food use and 39.4% (n=13) of families introduced a powder called “*Vibhaga Pohora*” made by dried drumstick leaves and sprat heads to increase the iron content and the taste. Families were empowered to prepare nutritious foods by cereals like “*Kurakkan*” in an attractive way, and bakery products were reduced. Analysis showed children’s proper nutrition and good dietary practices were improved through the intervention. It can be concluded that the health promotion intervention was successful in empowering selected families to provide proper nutrition to children.

Keywords: *Children, empowering families, health promotion intervention, nutrition*

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A Health Promotion Intervention to Empower the Community for Reducing the Risk of being Overweight in a Semi-Urban Area Harispathhuwa, Sri Lanka

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Being overweight increases the risk for non-communicable diseases. Therefore, it's important to empower communities to reduce the risk of being overweight. This health promotion intervention aimed to empower community to reduce the risk of being overweight by addressing selected determinants. This intervention was carried out for one-year, with a group of 25 participants (age 20-65), Harispathhuwa, Sri Lanka. Discussions were facilitated and participants were guided to measure, record their waist-circumference. Then, unhealthy dietary-practices, lack of physical-exercise were identified as the main determinants to be addressed. Group-discussions were initiated through face-to-face discussions and continued via mobile-calls, zoom-sessions on importance of healthy dietary practices, physical-exercises for reducing overweight. Participant's enthusiasm towards the process was improved by using success-stories of health-promotion interventions and they were guided to design, implement activities to address those determinants. Process was continuously monitored. Data was collected through telephone interviews. Waist-circumference were measured by participants themselves and post data that dietary-practices, physical-exercises and waist-circumference were collected through telephone-interviews. Data was analyzed using descriptive-statistics and thematic-analysis. As results, most (92%;n=23(25)) of the participants mentioned, their sports-involvement and exercising minutes(>20min) has increased. Participants engaged in sports and increased exercising minutes (>20min) to increase physical activities than before. They followed different strategies to reduce salt, sugar and oil consumption like labelling sugar, salt, oil bottles and changing the bottle sizes. Further, participants mentioned, they changed the positive-attitudes towards junk-food and it helped to reduce their consumption. Reduced carbohydrate intake by reducing plates, portions and spoons sizes. Majority (88.0%;n=22(25)) of participants reported, they reduced the household oil, sugar, salt consumption than before. Most (92.0%;n=23(25)) participants reported, they reduced their waist-circumference following the intervention. Based on the results, it can be concluded that the implemented health promotion intervention was effective in empowering the selected community group to reduce the risk of being overweight by addressing selected determinants.

Keywords - *Empowering communities, dietary practices, health promotion intervention, physical activities*

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A Health Promotion intervention to Reduce the Non-Communicable Diseases Risk in a Rural Village

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Non Communicable Diseases (NCDs) lead to 41 million deaths globally and NCDs become responsible for over 75% of annual deaths in Sri Lanka. World Health Organization identified unhealthy dietary practices as one of the major risk factors for NCD's. This intervention aimed to empower mothers to reduce NCDs risk by addressing unhealthy dietary practices using the health promotion approach. The intervention was carried out for six months, with a group of 25 mothers in Kiraladugalagama village in Monaragala district. The process was initiated by improving mothers' enthusiasm, while improving their knowledge on NCDs risk factors and the importance of addressing the family-level risk factors. Then, they were guided to identify risk factors and they could prioritize unhealthy dietary patterns as one of the major risk factors of NCDs to be addressed. Next, mothers were guided to develop suitable indicators and to design activities by showing the success stories. During the Covid-19 period, the process was followed up via distance mode communication methods and the changes were assessed through the group discussions with mothers. The collected quantitative and qualitative data were analyzed using descriptive statistics and thematic analysis respectively. Among mothers 80% (n= 25) could reduce the levels of sugar, salt and, oil consumption by using different strategies like 'Oil Meter', maintaining 'Kitchen Calendar', 10 mothers reported that they reduced starchy food and junk food consumption and increased the consumption of nutritious food prepared using grains. Furthermore, 7 mothers could reduce their waist circumference, all participants improved their knowledge on NCDs' risk factors and improved their ability to identify risk factors following the intervention. Implemented Health Promotion intervention was successful in empowering mothers to change unhealthy dietary practices.

Keywords: Health promotion intervention, NCDs risk, unhealthy dietary practices

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Socio-Demographic and Maternal Factors Influencing the Level of Knowledge of Nutrition during Pregnancy among Antenatal Mothers in the Chankanai MOH Area in the Jaffna District

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Nutrition plays a vital role in maternal health. This descriptive, cross-sectional, institution-based study aims to assess the influence of socio-demographic and maternal factors on knowledge of nutrition during pregnancy among antenatal mothers in the Chankanai MOH area in the Jaffna district. The study was conducted among 281 pregnant mothers attending antenatal clinics in the study area. Primary data were collected using an interviewer-administered questionnaire. Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine of the University of Jaffna. Association between the socio-demographic and maternal factors and knowledge of nutrition among pregnant mothers was analyzed by way of the chi-squared test using the Statistical Package for Social Sciences (version 23). The age range of the participants was 18-43 years with a mean value of 28 years. The highest proportion of respondents (61.2%, n=172) studied up to GCE O/L and 6% (n=17) of the participants were graduates. A major proportion of the spouses of the respondents (67.6%, n=190) studied up to GCE O/L. Among the participants, 18.9% (n=53) had good knowledge, 73.3% (n=206) had satisfactory knowledge and 7.8% (n=22) had poor knowledge. Results reveal that the education level ($p < 0.000$) has a statistically significant association with the level of knowledge about nutrition among the participants. Age ($p=0.022$) significantly positively correlated with the level of knowledge about iron. Age significantly ($p=0.030$) positively correlates with the attitude of the participants towards restricted foods during pregnancy. There is no statistically significant association between employment status and level of knowledge of nutrition. Results also indicate that there is no statistically significant association between Husband's education and level of knowledge on nutrition among the antenatal mothers. Results also highlight that there is no statistically significant association between total monthly income of the family and level of knowledge of nutrition among the antenatal mothers. The total family income per month significantly ($p=0.005$) positively correlates with the nutrition-related practices of pregnant mothers. This study recommends that more emphasis should be given to nutritional intervention programs for antenatal mothers.

Keywords: Age, attitude, education, income, maternal factors

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Comparison of blood glucose responses of cane sugar versus coconut jaggery in type 2 diabetes patients

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Type 2 diabetic mellitus is a predominant metabolic disorder that has a direct impact on human health. Although scientific data are deficit, coconut jaggery has been suggested as a better alternative for cane sugar by some⁴ individuals. This study was conducted to assess the credibility of this claim. Coconut jaggery was prepared at Coconut Research Institute, Sri Lanka and nutritional composition of coconut jaggery was compared with cane sugar using standard methods. Significantly higher ($P<0.05$) moisture ($8.92 \pm 0.22\%$), ash ($2.09 \pm 0.33\%$), protein ($1.91 \pm 0.28\%$), fat ($0.14 \pm 0.02\%$) and fiber ($0.05 \pm 0.03\%$) contents were observed in coconut jaggery compared to cane sugar. The total starch and total sugar content of the coconut jaggery was significantly ($P<0.05$) lower than that of the cane sugar. Forty-three (Male: 16, Female: 27) type 2 diabetes patients from the Endocrinology unit, National Hospital, Colombo- Sri Lanka were voluntarily engaged in the study subjected to an initial health screening. Then, determination of postprandial blood glucose responses after intake of the standard (glucose), cane sugar and coconut jaggery were tested respectively on each patient keeping one week resting period between consecutive tests. Average age of the selected group was 48.19 ± 7.95 years and they were all overweight ($BMI > 23.0$). The mean fasting blood glucose level and HbA1c of the subjects were 149.05 ± 54.88 mg/dl and 9.170 ± 2.022 % respectively. There was no significant difference ($P > 0.05$) in peak blood glucose concentrations or incremental area under the curve (IAUC) in blood glucose response curves drawn after consumption of coconut jaggery and cane sugar. Coconut jaggery might be beneficial for healthy individuals as it contained significantly higher nutrients compared to table sugar. However, it cannot be considered as a healthy substitute for cane sugar for type 2 diabetic patients.

Key words: Cane sugar, coconut jaggery, glycemic responses, type 2 diabetes

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Personal recollections of the early history of the Nutrition Society of Sri Lanka

It was in November.1971, when I was the Registrar to the Professor of Paediatrics, In the University paediatric unit at the Lady Ridgeway Hospital that I became aware that a new society called the Nutrition Society had been formed at a meeting summoned for the purpose at the Nutrition Division of the Medical Research Institute (MRI). The key movers in this initiative had been Prof CC de Silva, the Emeritus Founder Professor of Paediatrics of the University of Ceylon and Dr K. Mahadeva, Nutritionist at MRI. As far as I am aware the others present at the meeting had included Prof TW Wickramanayake, Professor of Biochemistry at the University of Peradeniya, Prof Priyani Soysa, Professor of Paediatrics at the University of Colombo and other members of the Nutrition Division of MRI, Dr CC Mahendra and Dr B V De Mel.

In August 1974 as a Lecturer in Paediatrics I presented a paper on “The Prevalence of Protein Energy Malnutrition in Children” at the Annual Sessions of the Sri Lanka Paediatric Association. It was awarded the Adigar Sellamutthu Gold Medal for best Scientific Presentation at the sessions by a panel of judges chaired by Prof JH Hutchison, Professor of Paediatrics at the University of Glasgow. At the end of the sessions Prof CC De Silva complimented me and suggested that I should join the Nutrition Society. As I proceeded on postgraduates to leave to the United Kingdom soon after I did not play any role in the society's activities till my return to Sri Lanka in 1977.

One of the most important things that happened during the tenure of Prof TW Wickramanayake as president was the visit of Dr L Joy and Mr PR Payne from the London School of Hygiene and Tropical Medicine and a high level policy discussion with their participation, which paved the way for the establishment of a Food and Nutrition Policy Planning Unit within the Ministry of Plan Implementation which came directly under the executive president. Dr Wickrema Weerasooriya was the Secretary of the Ministry. A senior civil servant Mr Lal Wijepala was appointed as the first Director. This paved the way for creation of a National Co-ordinating Committee for Food and Nutrition under the chairmanship of Dr Wickrema Weerasooriya. Several members of the executive committee of the Nutrition Society were appointed to this committee and many others were recruited as technical experts for specific tasks.

Prof Priyani Soysa was the President of the Nutrition Society in 1977. She requested me and Dr Dulitha Fernando, my colleague from the Department of Community Medicine, university of Colombo be joint secretaries for second year as president in 1978. We continued in 1979. Since then I continued as a council member of the society until my departure on sabbatical leave in 1989. I was the Vice President in 1984/85 and President in 1986/87. Along with a few others, I was given a special award for my contribution to the Nutrition Society in 2006. I think my biggest contribution to the Nutrition Society was broad basing the membership of the nutrition society under the guidance of Prof Priyani Soysa. Till 1977 the membership of the Nutrition Society was almost exclusively those with a medical background. Except for the two dieticians of the GH Colombo, Mr LAC Alles a food scientist from the Department of Marketing Development and Prienne Ranatunge a veterinarian with an interest in nutrition from the Vetenary Research Institution (VRI). There were hardly any without MBBS. In 1977 we engaged in a high level recruitment drive enrolling members from many related disciplines, economists like Mrs Pat Alailima Director of Economic affairs in the Treasury, educationists such as Mr Mahinda Rana weera, Deputy Director General of Education and agriculturists like Mr TB Subasinghe who was the Director of the Agrarian Research and Training Institute (ARTI)

The first non-medical President of the society was Mrs Premani Samarasinghe who was the senior Dietician at the General Hospital, Colombo. At the time of her election Mr TB Subasinghe of the ARTI succeeded her as President in 1981. During his second term as president in 1982, he got the Nutrition Society incorporated by an act of parliament as the professional body for the discipline of Nutrition in Sri Lanka. I am proud to have been a member of its council in the year of its incorporation. Dr Brightie DeMel succeeded Mr Subasinghe as the President. In 1982.

This objective of broad basing the membership of the Nutrition Society was highly successful. Nutrition being a truly multi-disciplinary subject professionals from many institutions which had some link to food and nutrition sought membership of the Nutrition Society and many later held office in different posts in the council. The institutions that contributed members to the society included MRI, Family Health Bureau and Health Promotion Bureau of the Ministry of Health, The departments of biochemistry, community medicine and paediatrics from universities, The CISIR which subsequently was renamed as ITI, ARTI, Farm Women's Agricultural Extension project, Curriculum Development Centre of the Ministry of Health, and later the NIE, Marketing Department and The CWE from the Ministry of Trade, FNPPD of the Ministry of Plan Implementation and Project officers from national and International NGOs. Unfortunately there were no University Departments of Nutrition or Food

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Science/ technology at that time. Some members from Industry too enrolled in the society. I have already sent you a report of all the activities carried out by the NS in its early period. The NS from the outset had an affiliation to the International Union of Nutrition Sciences (IUNS) and some of our members participated actively in IUNS.

These are my recollections of the early history of the NS. I have recounted them to the best of my memory, double checking with records that I have. I hope they will be of assistance in writing the history of the NS. I will be glad to be of further assistance if required.

Prof Narada Warnasuriya
30.05.2021

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- The keynote speaker, Prof. Narada Warnasuriya(Past President- NSSL), Senior Professor of Paediatrics, Department of Paediatrics, Faculty of Medicine, General Sir John Kotelawala Defense University,
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- All others who supported the event in numerous ways.

The panel of judges

- Prof. Indu Waidyatilaka, Department of Biochemistry and Molecular Biology, Faculty of Medicine, University of Colombo
- Prof. U. K. P. Hettiarachchi,, Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayawardenapura
- Dr. Isuru Wijesekera, Department of Food Science and Technology, University of Sri Jayewardenepura
- Prof. Sureka Chackrewarthy, Department of Biochemistry and Clinical Chemistry, Faculty of Medicine, University of Kelaniya
- Prof. Odan Perera, Department of Food Science & Technology, Faculty of Livestock Fisheries & Nutrition, Wayamba University of Sri Lanka
- Prof. Manjula Hettiarachchi, Nuclear Medicine Unit, Faculty of Medicine, University of Ruhuna
- Dr Prasanna Gunathilaka, Department of Food Science & Technology, Faculty of Livestock Fisheries & Nutrition, Wayamba University of Sri Lanka
- Dr. Kumari M Rathnayake, Department of Applied Nutrition, Faculty of Livestock Fisheries & Nutrition, Wayamba University of Sri Lanka
- Dr. Buddhika Perumpuli, Department of Food Science & Technology, Faculty of Agriculture, University of Ruhuna
- Dr. Thilanka Ranathunga, Department of Applied Nutrition, Faculty of Livestock Fisheries & Nutrition, Wayamba University of Sri Lanka
- Senior Prof. Pujitha Wickramasinghe, Department of Paediatrics, Faculty of Medicine, University of Colombo

The panel of evaluators - NSSL awards

- Senior Prof. Pujitha Wickramasinghe, Department of Paediatrics, Faculty of Medicine , University of Colombo
- Prof. U. K. P. Hettiarachchi, Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayawardenapura
- Prof. Manjula Hettiarachchi,, Nuclear Medicine Unit, Faculty of Medicine, University of Ruhuna
- Prof. Vijitha de Silva, Department of Community Medicine, Faculty of Medicine, University of Ruhuna

The Nutrition Society of Sri Lanka Council 2020-2021



Seated from Left to Right-

Dr. Dhammika Senanayake (Vice President), Ms. R.P.M. Sandamali (Joint Secretary), Prof. Chandima Wickramablake (President)
Dr. Ananda Chandrasekara (Joint Secretary), Mr. MRK. Dharmapriya (Treasurer).

Standing from Left to Right-

Dr. N Jeewakarathne, Ms. Eranga Harshani Silva, Ms. Malika Gayathri Fernando, Ms. Josepkumar Thamlini,
Dr. W.V.R.T.D.G. Bandara, Prof. Terrence Madhujith, Dr. N Jeewakarathne

Absent:

Dr. Disna Kumari (Editor), Prof. Anoma Chandrasekara, Ms. Pramudi Hasanga Rathnayake