

# Annual Scientific Sessions of The Nutrition Society of Sri Lanka



**Translating Nutrition Research into Action;  
Beyond 2020**

## **ABSTRACTS & INVITED PRESENTATIONS**

**January 25 - 26, 2020**  
Taj Samudra Colombo, Sri Lanka



## **PROCEEDINGS**

Annual Scientific Sessions of  
the Nutrition Society of Sri Lanka

**“Translating Nutrition Research into Action; Beyond 2020”**

**25-26 January 2020**  
**Taj Samudra, Colombo**  
**Sri Lanka**

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**Proceedings: Annual Scientific Sessions – 2020**

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**The Nutrition Society of Sri Lanka**

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## **Message from the President**

Dear Colleagues

I welcome you all to the annual scientific sessions 2020 of the Nutrition Society of Sri Lanka. The Nutrition Society of Sri Lanka is the leading organization among others in Sri Lanka with more than 500 members serving in multifaceted professions related to nutrition. The aim of the society is to promote nutrition science among Sri Lankans to enhance education and application influencing best practices and policies to improve health and nutrition.

The theme of this year is “Translating nutrition research into action, beyond 2020”. In the two days programme we will discuss several aspects needed to enhance health and wellness of our people. This year we add a feature symposium to address personal development of our members, Standing on your own feet. In addition free papers presented by researchers will add much enthusiastic thoughts on nutrition issues. This year we introduce flask talks to our presenters.

We are as a society reaching to the 50<sup>th</sup> anniversary celebrations. All throughout the passing years under the leadership of dedicated presidents and council members the society achieved remarkable success in advocacy, capacity building and communication in the field of food and nutrition.

The membership is growing year by year, The multifaceted nature of the discipline of nutrition needs to be emphasized. Nutritionists are important fraction of the human resources. They can influence the thinking of people and the development of the country. The Nutrition Society of Sri Lanka has secured several collaborations with foreign universities and UN agencies.

The scientific sessions are possible with the support of council, wider membership and well-wishers who volunteered time, energy and knowledge. Their contributions are invaluablely acknowledged.

Prof Anoma Chandrasekara

President/NSSL



# Annual Scientific Sessions of the Nutrition Society of Sri Lanka

25<sup>th</sup> & 26<sup>th</sup> January 2020



@ Taj Samudra  
Colombo

## Translating nutrition research into action beyond 2020



# Programme JAN 25

8.00-9.00

**Registration**

9.00-9.10

**National anthem & Lighting of oil lamp**

9.10-9.20

**Welcome Dance**

9.20-9.25

**Welcome - President NSSL**

9.25-9.35

**Address -Chief Guest**

Mrs. Bhadrani Jayawardena  
Secretary / Ministry of Health and Indigenous Medical Services

9.35-10.05

**Keynote address**

**Feeding the Future and Technology**

Prof Ajith de Alwis  
Senior Professor, Department of Chemical and Process Engineering, University of Moratuwa

10.05-10.25

**President address**

**Hunger and obesity in Sri Lanka; Research gaps and opportunities**

Prof Anoma Chandrasekara

10.25-10.30

**Vote of thanks**

Dr Madhu Wickramathilaka, Joint Secretaries, NSSL

10.30-10.40

**Entertainment break-Dance**

10.40-11.00

**Break & Poster Display**

11.00-11.10

**Mindfulness break**

Dr Sanath Mahawithanage

11.10-11.40

**Plenary Lecture**

**Awaken your hidden power**

Mr Dilith Jayaweera  
Group Chairman, George Steuart & Co

11.40-1.00

**Symposium 1** (20 min each with common discussion of 15 min)

**Standing on your own feet**

**Speech 1 Way to make your dreams real**

Mr. Dilhan C Fernando  
CEO, Dilmah Ceylon Tea Company PLC

**Speech 2 Getting to the top**

Mr Dilan Angunawela  
Senior Manager HR, Hemas Pharmaceuticals (Pvt) Ltd  
Hemas Surgical and Diagnostics (Pvt) Ltd

**Speech 3 Selling yourself**

Dr Kapila Sooriyaarachchi  
Communication Specialist, Head of Health Promotion Division  
Public Health Department, Colombo Municipal Council

1.00-2.00

**Lunch & Poster Display**

2.00-3.00

**Symposium 2** (20 min each with common discussion of 15 min)

**Functional foods and nutraceuticals in disease management**

**Speech 1 Bioactive lipids: What can they do?**

Prof Terrence Madhujith  
Professor Chair, Department of Food Science Technology  
University of Peradeniya

**Speech 2 Phytochemicals and their functions, safety, and efficacy**

Dr Prasanna Gunathilaka  
Senior Lecturer, Department of Food Science Technology  
Wayamba University of Sri Lanka

3.00-5.00

**Break and AGM**

5.00-6.00

**TW Wickramanayake Memorial Oration** (40 minute speech)

**An Overview of Food and Nutrition Policies of Sri Lanka**

Dr Indra Thudawe

# Programme JAN 26

08.30-09.00

## Registration

09.00-10.15

## Symposium 3 (20 min each with common discussion of 15 min) Public Health Nutrition

### Speech 1 Dietary and lifestyle management for obesity and diabetes

Prof Upul Senerath  
Professor in Community Medicine Department of Community Medicine  
University of Colombo

### Speech 2 Dietary diversification in chronic disease management: Legume consumption, acceptance and its role in colorectal cancer prevention

Dr Thushanthi Perera  
Senior Lecturer, Department of Applied Nutrition  
Wayamba University of Sri Lanka

### Speech 3 Secondary school food literacy education: Importance, challenges, and ways of improving

Dr Janandani Nanayakkara  
Lecturer, Department of Applied Nutrition  
Wayamba University of Sri Lanka

10.15-10.45

## Break & Poster Display

10.45-11.00

## Mindfulness break

Dr Sanath Mahawithanage

11.00-11.30

## Plenary Lecture Cardio-metabolic disease development amongst the Sri Lankan population

Prof Mahinda Y Abeywardena  
Senior Principle Research Scientist  
The Commonwealth Scientific and Industrial Research Organization  
Health & Biosecurity, Australia

11.30-12.45

## Symposium 4 (20 min each with common discussion of 15 min) Nutrition Research; challenges

### Speech 1 Community nutrition assessment; field research challenges

Dr Renuka Jayatissa  
Head of the Department of Nutrition  
Medical Research Institute Sri Lanka

### Speech 2 Challenges of determining Nutritional value of Sri Lankan dishes

Dr Ranil Jayawardane  
Senior Lecturer, Department of Physiology  
University of Colombo

### Speech 3 Dietary modeling for optimal diet prescriptions

Prof Renuka Silva  
Professor Chair, Department of Applied Nutrition  
Wayamba University of Sri Lanka

12.45-1.40

## Lunch & Poster Display

1.40-2.00

## Flash Talks

(3 minutes drills of poster presenters) (6 communications)

2.00-3.00

## Free Communications

(6 communications 8 min each with common discussion)

3.00-3.30

## Break & Poster Display

3.30-4.30

## Panel Discussion on Nutrition Research into action beyond 2020

Panelists: Ananda Chandrasekara, Renuka Jayatissa, Renuka Silva, Ranil Jayawardane, Chandima Wickramathilaka, Visaka Tillekeratne – Moderator Sanath Mahawithanage

4.30-5.00

## Closure of sessions & concluding remarks

Mr Roshan Delabandara  
Session Coordinator

## **Prof TW Wickramanayake Memorial Oration**

### **An overview of food and nutrition policies in Sri Lanka**

#### **Indra Thudawe**

Sri Lanka achieved significant social and economic gain since independence due to its extensive welfare policies— however, challenges remain in reducing malnutrition. Malnutrition has a high cost both socially and economically to a household and society. Such costs, to name a few, translate to poor cognitive and growth development and learning abilities in childhood and low labour productivity as adults. The high prevalence of stunting and underweight in 1970's did significantly decline with state investments to improve food, income, environment and health security. Nevertheless, since 2000, the rate of reduction of undernutrition has been slow despite continued heavy state investments. Recognising this situation, the Ministry of Health launched a Nutrition Policy in 2010. Further, appreciating the need for a wider and inclusive participation of key stakeholders and a multi-disciplinary approach, this policy was updated with a Multi-Sector Nutrition policy and action Plan in 2014. Due to the importance assigned to tackling malnutrition, the oversight function of this policy rested with the National Nutrition Council chaired by the President of the country. However, the latest national data (2016) show limited improvement in undernutrition and overnutrition rates. Therefore, the effectiveness of these policies are examined through available published data and research. The findings reveal the necessity to emphasise existing investments more on a “needs basis” to vulnerable households. Vulnerability of a household/individual is dynamic and varies with life/living condition as illness, disabilities, income insecurity, unemployment, inadequate access to services, information and changing life styles to name a few. Hence the development of more a robust mechanism to identify local level nutritionally-vulnerable household demands further attention. In addition, the current multi sectoral administrative structures, services and resources require further consolidation to achieve the common goal of improved nutrition. Closer collaboration, better coordination and commitment of all key government Ministries, private sector and community level organisations from the lowest administrative level to national, are pre-requisites towards more effective and efficient use of to all resources. Especially when considering that additional state investments for nutrition interventions appear unlikely in the near future due to high debt ratio of the country. Further, it is essential for service providers and stakeholders to access real time data and information on the vulnerable population for necessary action. Towards this improved collection of reliable administrative data on local population and validation either through periodic national surveys or other methods deem further refinement. Finally, together with stakeholder services, unless sufficient demand is created at the household level to appreciate the value of adequate nutrition for their own welfare, the results may fall short of expectations.

## **Keynote Address**

### **Feeding the Future and Technology**

**Ajith de Alwis**

Department of Chemical and Process Engineering, University of Moratuwa

As we have entered into a new decade there are many challenges facing us. The decade is to end with 2030 and this is an year where so many predictions and expectations coincide. If all goes well 2030 would see an emerging world where poverty has ended with no one left behind – meeting of all SDG's. 2030 is also expected to see the machine exceeding the capacity of its original creator the human being – an year of singularity.

Malthus in 18<sup>th</sup> century forewarned the emergence threat to mankind because of the population explosion and the inability to meet food demand. Emerging Technology at the time however ensured that Malthus was proved wrong. However the emergence of several other technologies has contributed to significantly increase in population and when we approach 2050 the world is expected to have closer to 9 billion people. An era of population stability is to emerge afterwards. Hence the era that would really challenge the mankind again is the period 2030-2050 from this issue – Would Malthus be proved correct after all? It is indicated that in the next three decades we have to produce food in amount equal to what we have produced in the previous 10,000 years. This indeed is an alarming projection with each country having to produce 60-70% more.

We are also indicating some preference to rebel against technologies. There is strong belief in some quarters that technology is at the root of all evil when it is come to food. As a nation we appear to be faltering on both food security and nutrition security at present. The decade is fresh. The challenges have been identified even if not validated. The steps we take today will yield results tomorrow. Is there a choice when it comes to the use of emerging technologies?

## **Symposium 2: Functional foods and nutraceuticals in disease management**

### **Bioactive lipids: What can they do?**

**Terrence Madhujith**

Department of Food Science & Technology, University of Peradeniya

Lipids are generally perceived as a group of food constituents associated with negative health impact leading to obesity, cardiovascular diseases cancer and neurodegenerative disorders among others. However, lipids play a key role in providing energy, help absorbing fat soluble vitamins, providing essential fatty acids, maintaining the structure of cell membranes, metabolic and gene regulation, cell signaling and transduction. Lipids have also been intimately linked to cell proliferation, immune and inflammatory responses and mediation of apoptosis.

Nearly twenty major fatty acids are commonly found in foods and biological systems which impart differential health and nutritional effects, thus the fatty acid profile of a lipid source largely determines its nutritional and health impact. None of the natural lipid sources offer the optimal fatty acid profile which has necessitated the importance of altering the fatty acid profile through chemical or enzymatic means. The process known as interesterification can bring about drastic changes in the fatty acid profile of lipids. The resulting lipids, termed structured lipids are more beneficial than the natural counterparts. The research group of this author recently reported synthesizing a structured lipid by modifying the fatty acid composition of coconut oil.

The positive nutritional role of monounsaturated fatty acids [MUFA], polyunsaturated fatty acids [PUFA], omega-3 fatty acids and medium chain fatty acids is well established. The positive role of omega-3 PUFA against the development of hypertriacylglycerolaemia, vascular dysfunction, atherosclerosis, cardiac arrhythmia, myocardial infarction, inflammatory conditions, insulin resistance, neurodegenerative diseases of ageing and some cancers among others. The vital role of arachidonic acid and DHA in visual and brain development and of omega-3 PUFA in preventing cardiovascular diseases has been established.

Besides, the effects of conjugated linoleic acid [CLA] in mitigating carcinogenesis and weight management have raised much interest among scientists over the recent

past. *sn*-1,2-diacylglycerol (DAG), a metabolic intermediate is rapidly generated from the hydrolysis of membrane phosphoinositides through the action of receptor-regulated phospholipases. DAGs in association with cyclic nucleotide-independent protein kinase C (PKC) are attributable to curtail tumor progression, controlling chronic hyperglycemia and cardiac hypertrophy. Phosphoinositides, a minor group of glycerophospholipids are found to control many cellular signaling functions. They are implicated in reducing the incidences of oncogenesis, diabetes mellitus and X-linked myotubular myopathy. Lysolipids and sphingosine 1-phosphate (S1P) and lysophosphatidic acid (LPA) are identified as potent bioactive lipids with significant physiological and pathophysiological significance. Plasmalogens and other ether lipids, ceramides, glycosphingolipids, prostanoids, leukotrienes, lipoxins, isoprostanes, among others have been identified as strong bioactive lipids through recent work. It is evident that bioactive lipids can potentially bring about a wide array of nutritional and health benefits.

## **Phytochemicals and their functions, safety, and efficacy**

### **KDPP Gunathilaka**

Department of Food Science & Technology, Wayamba University of Sri Lanka

Plant secondary metabolites are rich sources of bioactives possessing various health benefits to human beings. Therefore, there is increasing interest and demand by nutritionists, researchers and consumers, into the roles that certain bioactives, derived from plants which can be playing a significant role in health maintenance, promotion, and prolong the productive quality of life. Research has rapidly emerged worldwide in recent decades and suggesting that a wide range of phytochemicals in plant-based foods, including vegetables, fruits, grains, seeds, nuts, and legumes as important sources of therapeutic and preventive agents against diseases and may exert substantial health benefits. Some of the most common plant-derived bioactive components include phenolics, coumarins, lignans, flavonoids, isoflavonoids, anthocyanins, tannins, quinones, stilbenes, alkaloids, terpenes, and saponins. The types of foods containing these bioactive constituents are those functional foods that provide desirable health benefits beyond their basic nutritional properties when consumed regularly and consistently through diet. Alternatively, dietary supplements can be supplied to consumers in a concentrated form to deliver a specific bioactive phytochemical or a group of phytochemicals. Usually, these nutraceutical ingredients are administered with higher doses than in normal food or in a medicinal form to improve human health. However, people start to be concerned with their health status nowadays, so the function and safety of dietary supplements are getting more and more attention. It has been estimated that several hundred million people worldwide taking dietary supplements daily to maintain their health. The botanical dietary supplements which are isolated from natural plants, in particular, holding more attention compared with others, and they have occupied an important and ever-growing portion of the market. Though these plant bioactives or nutraceuticals can provide health-essential and health-improving nutrients, they can be toxic to our body or be transformed into toxic compounds by our system. The efficacy and safety of bioactive compounds depend on a few known and unknown parameters and the working mechanisms of a large amount of botanical natural compounds remain unclear. However, it does not stop the use and the sales of botanical supplements continue to expand rapidly in our market. Especially, clinical trials, which can generate reliable data on both the efficacy and the safety of these bioactives or nutraceuticals on treating/preventing certain chronic diseases, are essential before widely applying them on the market. Therefore, there is interest in exploring the possibility of establishing recommended intakes or dietary guidance for certain bioactive substances to help educate consumers and a key aspect of establishing



dietary guidance is the assessment of safety/toxicity of these phytochemicals. Hence, toxicologists need to be involved in both the development of the safety framework and in the evaluation of the science to establish maximum intake/upper limits. However, there are some challenges and obstacles that these phytochemicals face concerning making intake recommendations and these challenges followed by future actions likely needed for clearing the path forward to dietary intake recommendations for bioactive phytochemicals.

### **Symposium 3: Public Health Nutrition**

#### **Dietary and lifestyle management for obesity and diabetes**

**Upul Senerath**

Department of Community Medicine, University of Colombo

Worldwide prevalence of obesity has tripled between 1975-2016 period, with more than 1.9 billion adults aged 18 years and older were overweight/obese. Type 2 diabetes (T2D) has become a global epidemic affecting an estimated 463 million people across the world. In Sri Lanka 34% of women and 25% men are overweight or obese, and around 15% the adult population is having diabetes. A systematic review of dietary and lifestyle interventions (2014) revealed that a significant reduction in weight can be achieved through dietary interventions. However the benefits were short-lived, as most studies fail to find differences at extended follow-ups. Even an efficacious treatment will have little impact if individuals are unable or unwilling to adhere to it.

Lifestyle interventions are defined as any intervention that includes exercise, diet, and at least one other component (e.g., counseling, stress management, smoking cessation, food provision, plate model). There is evidence that a comprehensive lifestyle intervention effectively decreased the incidence of T2D in high-risk patients. Different modalities have been identified such as face-to-face counseling, internet-based interventions, and mHealth interventions. m-Health is defined as provision of health services and information via mobile technologies such as mobile phones, tablet computers and Personal Digital Assistants. (WHO, 2011). A recent review concluded that e- and mHealth interventions were effective in promoting physical activity and healthy diets in developing countries. However, the future interventions should use more rigorous study designs, investigate the cost-effectiveness and reach of interventions.

## **Dietary diversification in chronic disease management: Legume consumption, acceptance and its role in colorectal cancer prevention**

**Thushanthi Perera**

Department of Applied Nutrition, Wayamba University of Sri Lanka

Ample scientific evidence suggests the disease prevention benefits of regular legume consumption. Although legumes are being recognized as a food group with dietary recommendations (DRs), less than 15% of U.S. adults consume legumes on a given day. Given this backdrop, the objectives of this study were to evaluate legume consumption patterns in U.S. adults by using cross-sectional data from the 2011-12 and 2013-14-year cycles of NHANES and a cross-sectional, on-line survey conducted using families around Corvallis, Oregon named “Beans, Lentils, Peas (BLP) Survey” and to identify reasons for the disconnect between DRs and legume consumption patterns in U.S. adults.

In an online survey, we identified benefits, barriers, and preferences for legume consumption in adults. To better understand their food choices, we subdivided respondents based on their recent legume consumption pattern; none, below current DRs (<37.5 g/d; low), above current DRs but below levels demonstrating nutritional and disease prevention benefits (37.5-87.49 g/d; marginal) and disease prevention legume consumers ( $\geq 87.5$  g/d legume consumption). Groups were compared using t-tests (for comparison of legume consumers vs. non-consumers) or generalized least-squared means (for comparison among legume consumer groups) for continuous data and a chi-square test (NHANES) or Fisher’s exact test (BLP) for categorical data. All tests were two-sided. Significance of group differences was determined at  $P \leq 0.05$ .

Based on legume consumption data we found out that legume consumption remained low in U.S. adults with a declining trend from 2011 to 2014 (mature legumes: 12.8 to 8.3%; dry beans: 10.0 to 6.5%). Less than 5% of the population consumed legumes on a daily basis; approximately 1/3 of the population did not consume legumes during the last month. Low consumers ate a limited variety of legumes (dry beans and green legumes) on a weekly to monthly basis. Disease prevention consumers (16% of the population) ate legumes daily or every other day and included chickpeas, lentils and dry peas to their legume mix.

Based on their perceptions, three legume consumer groups were identified corresponding to recent legume consumption; ‘skeptics’ (non-legume consumers), ‘starters’ (low/marginal legume consumers), and ‘experienced’ (disease prevention legume consumers). Independent of their legume consumption patterns, respondents were not aware of the disease prevention benefits of regular legume consumption. The differences between those who consume sufficient amounts of legumes and those who do not centered around, differences in perceptions of taste and texture and of gastro-intestinal health. Those who consume sufficient amounts of legumes enjoy their taste and digestive benefits, whereas, non-consumers dislike

their taste and texture and experienced gastro-intestinal discomfort after consuming them.

Legume consumption declined rather than increased in U.S. adults, warranting improved communication about the disease prevention benefits of regular legume consumption. Reasons for differences in varied legume consumption are that regular consumers are experienced in using a variety of legume types, dishes, and preparation techniques, whereas non-consumers have limited interest or knowledge about legumes' disease prevention benefits, type and dish variety and preparation techniques, which should be the focus of future legume information materials.

## **Secondary school food literacy education: Importance, challenges, and ways of improving**

**Janadani Nanayakkara**

Department of Applied Nutrition, Wayamba University of Sri Lanka

Food literacy (FL) education at secondary school can provide both immediate and long-term benefits for adolescents. The exploration of multiple stakeholders' opinions on the importance and challenges of school FL education and their suggestions for its improvement will help the design and execution of future FL-related curricula and programmes. This presentation focuses on a series of studies done in Australia and two preliminary studies done in Sri Lanka to explore stakeholders' opinions of school FL education.

Two qualitative studies and an online survey were conducted to explore a broad range of Australian food-related professionals' opinions of secondary school FL education. Thirty-four food system professionals and 14 teachers participated in the interviews and 155 food-related professionals completed the online survey. Another online survey was administered to 1086 Australian parents and young adults drawn from a commercial research panel. Overall, food-related professionals believed that FL education is important for secondary school students. They identified several challenges for FL education including; competition with compulsory subjects, perceived low academic status of FL subjects, and inadequacy of resources. Their suggestions for improving FL education included: incorporation of relevant content, the presence of strong practical components, offering FL as compulsory subjects or the incorporation of FL concepts into compulsory subjects. Moreover, they proposed the active contribution of both internal and external stakeholders in the planning and delivery of FL education to upgrade its quality and relevance. Over half of parents and young adults agreed that food education should be compulsory for years 7-10 and one-third agreed that it should be compulsory for years 11-12. A majority suggested 1-3 hours per school week for food education. A qualitative study was done with 25 teachers in Giriulla and Kuliypitiya education zones of the North-Western province of Sri Lanka to explore their opinions of challenges associated with secondary school FL education. Parallely, a survey was conducted with 367 secondary school students (grades 8-10) in the same education zones to explore their FL level. The teachers mentioned several challenges including; the need for change in the existing curricula, inadequate teacher training programmes, violation of school canteen policies, and lack of resources for FL education. The mean food literacy score of the adolescents was  $166 \pm 20$  out of 217. Fifty-two percent of adolescents had higher food literacy and 48% had lower food literacy (based on median).

In conclusion, Australian food-related professionals strongly supported the need for FL education for secondary school students and suggested multiple ways for its improvement. The young adults and parents in Australia value food education highly and support raising the status of this form of life skills education in secondary schools. In Sri Lanka, school teachers face many challenges in secondary school FL education and there are gaps in the FL level of secondary school students.

## Plenary Lecture

### Cardio-metabolic disease development amongst the Sri Lankan population

**Mahinda Y Abeywardane**

The Commonwealth Scientific and Industrial Research Organization - Health & Biosecurity, Australia

Cardio and cerebrovascular diseases (CVD) within Sri Lanka, a nation of 23 million, account for 40% total deaths, which is a rate considerably higher than many Western countries (1). Neither an excessive total fat intake nor an increased level of more traditional lipid markers - total and LDL-cholesterol (LDL-C) - fully account for this increased vulnerability (2). Sri Lankan dietary habits are skewed towards higher intakes of highly digestible carbohydrates, saturated fat and notably insufficient intakes of omega 3 and omega 6 polyunsaturated essential fatty acids (EFA) namely linoleic (LA, 18:2 $\omega$ 6) and  $\alpha$ -linolenic (LNA, 18:3 $\omega$ 3). Diets rich in carbohydrate, in the absence of adequate EFA intake, not only promote *de novo* lipogenesis (DNL) but also hyperinsulinemia, hypertriglyceridemia and abnormalities in lipoprotein metabolism. Moreover, frank or borderline EFA deficiency adversely affect immune status, vascular health, liver and kidney functions, and all of these are prevalent in the Sri Lankan population. Vascular dysfunction leads to hypertension, the world's leading risk factor for cardiovascular deaths, as the tone of smaller blood vessels (arterioles) is a determinant of peripheral vascular resistance and therefore the blood flow. EFA status also modulates cellular membrane function(s) including the production of eicosanoids as well as the endogenous redox state thus influencing cardiovascular homeostasis via divergent biochemical pathways. Insufficient intake of quality proteins as evident in the Sri Lankan diet is also of major concern since this further exacerbates metabolic impairments. Furthermore, changing intake patterns of complex carbohydrates/ fermentable fibre needs attention, in view of accumulating evidence which links gut microbiome to cardiometabolic disease pathogenesis. Both the 'quantity and quality' of dietary fat are key determinants of insulin resistance (IR) and type 2 diabetes (T2D) and have received much attention. Nevertheless, it is noteworthy that the global explosion of obesity, T2D and associated metabolic abnormalities over the last decade has paralleled the increased consumption of refined carbohydrates including simple sugars. In the context of the latter, compared to Western dietary practices, Asian diets are lower in fat and higher in carbohydrates. Carbohydrates in excess promotes DNL, leading to storage of triglycerides, IR and could also influence the serum lipid profile. Hence, it is conceivable that the accumulation of fat in ectopic sites (namely, the liver and skeletal muscle) of such populations is to a large extent is carbohydrate driven. Such premise is reinforced by the rising incidence in non-alcoholic fatty liver disease (NAFLD) both in the obese and lean subjects (lean or non-obese NAFLD) amongst Sri Lankans.

1) World Health Organization (2014), Sri Lanka, <http://www.who.int/countries/lka/en>

2) Abeywardena M.Y. (2003) Dietary fats carbohydrates and vascular disease: Sri Lankan perspectives. *Atherosclerosis* 171: 157-161.

## **Symposium 4: Nutrition Research Challenges**

### **Community nutrition assessment; field research challenges**

**Renuka Jayatissa**

Department of Nutrition, Medical Research Institute, Sri Lanka

Community nutrition assessment is an ongoing process to assess nutritional problems and needs, design and implement appropriate interventions, evaluate nutrition programmes and provide feedback for future improvement of community health and nutrition. It needs to include community and relevant stakeholders as fully active participants. It requires specific data collection at community settings, which will be quantitative or qualitative, either directly from respondents or from secondary sources.

Major challenges are: assurance of the quality from the planning phase till dissemination of results, identifying correct investigation methods, choosing appropriate timing, balancing the finances, selecting correct and suitable equipment and supplies, providing adequate training for data collectors according to the research question and study settings, protocol violations, scientific misconduct etc.

To overcome challenges the appropriate supervision should be ensured during all the stages of data collection with the inbuilt system of process verification, so there will be no opportunity to compromise the results and quality of the assessment.

## **Challenges of determining Nutritional value of Sri Lankan dishes**

**Ranil Jayawardane**

Department of Physiology, University of Colombo

Nutrition transition that is affected by a wide range of socioeconomic and demographic shifts has resulted in rapid changes in the diets of most regions of the world. Sri Lanka, has also experienced this so called nutrition transition in recent decades which has lead the country to suffer from the double burden of under- and over-nutrition. The trends in risk factors such as increased consumption of energy-dense, nutrient-poor foods that have high amounts of fat, sugar and salt, for increased NCD related morbidity and mortality, manifest an upward direction. According to recent studies, the corresponding percentages of Sri Lankan adults in the overweight, obese and centrally obese categories were 25.2, 9.2 and 26.2% and the age-adjusted prevalence for metabolic syndrome was 24.3% while 23.7% adults were suffering from hypertension, with one in every five adults aged above 20 years having either diabetes or pre-diabetes. On the other hand, a high prevalence of malnutrition among hospitalized patients has been reported recently. In addition, the prevalence of stunting, underweight, wasting and anaemia among children were 7.1, 16.9, 21.2 and 7.4%, respectively

However, nutrition intervention should be implemented at individual level; not only because an individual's age and sex will make a difference in food consumption, but also because each person will differ in height and weight and will have diverse dietary habits. It is well known that prior to prevention, the problem must be well identified; in this case, the habitual dietary intake of the individuals should be measured. The data that is thereby obtained will be useful in identifying nutritional status, monitoring dietary practices and studying the relationships between diet and diseases. In this lecture, I will discuss about the challenges of determining nutritional values and possible solutions.



## **Dietary modeling for optimal diet prescriptions**

**Renuka Silva**

Department of Applied Nutrition, Wayamba University of Sri Lanka

Adults and children in Sri Lanka often have low intakes of energy and essential micronutrients, resulting in compromised health, growth, and development of children and increased risk of non-communicable diseases in both adults and children. Intakes of iron, calcium, folate and zinc are often below recommendations, and biochemical deficiencies of these micronutrients have been reported. Effective nutrition intervention strategies to increase the micronutrient intake of diets in Sri Lanka are urgently needed to improve nutritional status and health. Effective food-based dietary strategies will be the most sustainable strategy to overcome nutritional problems if nutritionally adequate diets based on local foods can be successfully identified and promoted. For this purpose, food-based dietary guidelines (FBDGs) must be formulated that are simple, realistic, country-specific, culturally appropriate, and take into account the multiple factors influencing food choice. Formulating such FBDGs is a cumbersome, time-consuming and potentially biased consultation process.

Current FBDGs for Sri Lankans lack scientific evidence and had not used existing dietary patterns of the population. FBDGs are currently being reviewed and revised. It has been suggested to use diet modelling using the linear programming (LP). LP approach can be used to develop robust and optimized food-based recommendations using locally available foods commonly consumed by the target population to meet adequacy of nutrients within affordable cost. LP simultaneously takes into account multiple factors, including dietary patterns, nutrient content, and cultural. Furthermore, LP allows researchers to identify nutrients that are likely to remain low even in the best diets based on locally available foods.

A study was carried out using an LP approach to identify problem nutrients in adult women living in rural, urban and estate sectors in Sri Lanka and to provide essential information to develop food-based recommendations to meet adequacy of nutrients which are nationally important. One thousand 24-hour recalls of adult women (74% rural, 22% urban and 4% estate) were used to examine the dietary patterns. Calcium, folate, Iron and Zinc were identified as absolute problem nutrients. The potential nutrient-dense food sources for these nutrients were also identified. Even the optimal diets predicted by LP are unable to provide some of these micronutrients in adequate amounts. Hence, it can be concluded that the FBRs developed using LP can meet adequacy of most nutrients except iron, folate, and calcium. Nutrient gap identified from LP analysis suggests that it is advisable to consider supplementation, fortification and or well-planned behavioural change interventions in order to meet selected nutrient recommendations.

## **Oral Communications**

### **Effect of low carbohydrate diet on metabolic syndrome risk factors in overweight and obese adults**

**HMS Thasneem and A Chandrasekara**

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Gonawila ( 60170), Sri Lanka

Obesity is a complex disorder characterized by excessive adiposity, is a cause for immoderate morbidity and mortality. There is an increasing trend in the global and local prevalence of obesity. Although dietary interventions play the major role in the management of obesity, conventional dietary strategies often fail to produce sustainable weight loss and to prevent comorbidities. Low carbohydrate diet has been shown improvement in cardiovascular and metabolic risk factors however, still inconclusive. The aim was to evaluate the effect of low carbohydrate diet on metabolic syndrome risk factors associated with obesity. A quasi-experimental study was conducted using 18 overweight and obese participants recruited from 3 NCD clinics in Kurunegala district. Eligible participants were adults with BMI  $>23\text{kgm}^{-2}$  and/or waist circumference  $>80\text{cm}$  (women) and  $>90\text{cm}$  (men). The treatment group (n=9) was provided with individualized low carbohydrate diet plan and the control group (n=9) was provided with individualized conventional low-calorie diet plan. Data were collected at the baseline and after the follow-up period of 12 weeks. There were no significant reductions occurred in anthropometric, biochemical, clinical and dietary parameters in low carbohydrate group ( $P>0.05$ ). Whereas, body fat percentage, total cholesterol and LDL significantly reduced in low-calorie group ( $P<0.05$ ). The available evidence is conflicting to make a decision about the effectiveness of the diet programs due to the low compliance. The study approach did not produce enough dietetic and behavioural changes. Further extended study is needed with modified dietary approach to re-evaluate the effect of low carbohydrate diet in metabolic syndrome risk factors in overweight and obese adults.

**Keywords:** Low-calorie diet, low carbohydrate diet, metabolic syndrome risk factors, obesity, overweight

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka*

*Wayamba University Research Grant Scheme 2019*

## **Mapping the secondary school curricula (grade 6 – 11) for critical food literacy components**

**DT Kannangara, KDRR. Silva and GJM Nanayakkara**

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Food literacy is an individuals' ability to plan manage, select, prepare and eat food supporting achievement of personal health and sustainable food system. Food literacy education at secondary schools provides immediate and long-term health benefits to adolescents. The objectives of this study were to investigate the opinion of food and nutrition experts and school teachers on critical food literacy components (FLC) that should ideally include in the secondary school curricula, and to map secondary school curricula for the selected critical FLC. Thirty-seven components under four major themes: history of food, food systems, science of food and nutrition and influencers and issues and challenges were identified as important FLCs through literature survey. The opinion of 25 food and nutrition professionals and 23 teachers and teachers' instructors was sought for appropriateness of the FLC. Contents of text books and teachers' guides of secondary school curricula (Grade 6-11) were mapped against FLC. Majority of the experts and school teachers/instructors agreed to include all identified FLC to the secondary school curricula. Thirty-five FLC were identified in the present curricula of different subjects. Major subjects containing FLC are 'Practical and Technical Skills', 'Home Science' and 'Agriculture and Food Technology'. Most of the FLC were included as theory (knowledge domain) and skill and competency development was minimally addressed. All students do not expose to these FLC as they are invariably included in elective subject basket. In conclusion, majority of the proposed FLC are already included in the secondary school curricula addressing knowledge but not skills and competencies.

**Keywords:** Content mapping, curriculum, secondary schools, food literacy, adolescents

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka*

## **Evaluation of nutritional knowledge and food consumption pattern among students of Faculty of Agriculture, University of Jaffna**

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Poor eating habits are a major public health concern among university students who experience transition into university life, during which they are exposed to stress and lack of time. Objectives of this research were to assess the level of nutritional knowledge and to study about food consumption pattern of the students of Faculty of Agriculture, University of Jaffna. Descriptive research design was adopted. The sample constituted total of 305 students (235 females and 70 males). A self-administered, pre-tested structured questionnaire was used for the study. Informed written consent was obtained from each participants. The Statistical Package for Social Science 20 (SPSS 20) was used to analyze the data.

Around 70% of participants were aged between 21 – 23 years. Most of the students (96%) were residing in the hostels. Participants constituted omnivorous (68%), vegetarian (27%), lacto-vegetarian (1%), ovo-vegetarian (0.3%) and lacto-ovo-vegetarian (1%). The nutritional knowledge of the students varied among different batches, however overall level of knowledge was above 70%. Most of the students (87%) stated that they consume fast foods because of their appearance, pleasure and delicious taste. Widely consumed food items were starchy foods and oily foods and it is reported that healthy food consumption is low. Most of the students (61%) had normal body mass index, whereas, around 22% of the students had underweight. The nutritional knowledge level had significant correlation ( $p < 0.05$ ) with BMI, however, the correlation between fast food consumption behavior and BMI of students was non-significant. Therefore, the study concluded that food consumption pattern of residential university students is a critical factor that requires close attention.

**Keywords:** Body mass index, fast food, food consumption, nutritional knowledge

## **Past dietary patterns, present dietary intakes and health and nutritional status of Alzheimer's disease patients and matched non-Alzheimer disease subjects**

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Alzheimer's disease (AD) patients are frequently reported to have reduced nutrient consumption and malnutrition. Determining diet past diet-related risk factors and present health and nutritional status will aid prevention of further complications, treatment and care process of AD. The objectives of this study were to investigate past dietary patterns, present dietary intake and overall health and nutritional status of AD patients compared to Non-Alzheimer's (NA) individuals. A case control study of 36 AD patients and matched NA subjects (age: 59-76 years) was conducted. Past dietary patterns were assessed using food frequency questionnaire and present nutrients intakes and nutritional status were determined using 24-hour recall and Mini Nutrition Assessment (MNA) tool, respectively. Plasma lipids were also determined. AD patients consumed significantly higher frequency of bakery products during adulthood (odds ratio: 10.65) and significantly lower frequency of white rice, seafood, coconut oil and nuts (odds ratios: 0.356, 0.211, 0.337 and 0.241, respectively) compared with controls. MNA showed that 47% of NA individuals and 31% of AD patients were malnourished or at risk of malnutrition. Dyslipidemia was diagnosed in 37% of NA individuals and 22% of AD patients. There was no significant difference found in present macronutrient intake between both groups and their intake were at recommended ranges. In conclusion, higher bakery products and lower rice, sea food coconut oil and nut consumption were associated with AD. This elderly population has a high prevalence of malnutrition and dyslipidemia. Interventions to address those issues are crucial for an effective treatment and care process of AD.

**Keywords:** Alzheimer's disease, case-control study, past and dietary intake, malnutrition, dyslipidemia

*Ethical approval was obtained from the Faculty of Medicine, University of Kelaniya (reference no. P/116/06/2015). The study was funded by the Coconut Research Institute, Sri Lanka.*

## **Diet modelling: can Sri Lankans achieve dietary recommendations through current food patterns?**

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Diet modeling is a process which attempts to translate recommended dietary allowances (RDA) into foods considering current dietary patterns of different cultures and socio-economic groups, food supply, food availability, sustainability, accessibility in the country. The objective of the study was to translate the RDA of nutrients into whole food diets in terms of minimum number of serves optimizing the nutrient recommendations while achieving energy requirements. One thousand, 24-hour dietary recalls proportionately representing urban, rural and estate women populations were used as dietary data source for current food patterns. Intake of calcium, iron, zinc, folates, vitamin A and vitamin C and serves from food groups except cereals were lower and carbohydrates and cereal serves were greater than the recommendation. Omnivore foundation diets (FD) which consists of food group composites (cereals, fruits, vegetables, dairy, fish-meat-eggs, pulses) were developed for the smallest and least physically active person for different age/gender groups. FD achieved RDA for selected nutrients while optimizing energy requirement. Omnivore foundation diets were extended to 7-day simulated total diets for different age/sex groups by replacing food group composites with commonly consumed foods. Total diets fulfilled 90%-110% of RDA for macro and micronutrients, except iron for adolescents and adult women. Developed diet models consisted of relatively higher amounts of fruits, vegetables, fish and dairy groups compared to present intakes. In conclusion, even though current food pattern is not favourable in achieving RDA, well planned diets using increased number of serves of commonly consumed foods enable population groups to achieve RDA.

**Keywords:** Composite foods, Diet modeling, Food based dietary guidelines, Foundation diets, Total diets

## **Cardiovascular risk factor prevalence is higher among post-menopausal women compared to premenopausal women**

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Cardiovascular disease (CVD) is the leading cause of death in worldwide. Both modifiable and non-modifiable risk factors contribute for the cardiovascular disease risk. Hormonal changes during menopause lead for physiological changes that increase the risk of cardiovascular disease. This cross-sectional study was carried out in Pannala Divisional Secretariat in Sri Lanka to investigate association between cardiovascular risk factors and menopausal status. A total of 236 subjects from pre-menopausal (n=118) and post-menopausal (n=118) Sri Lankan women aged 30-60 years were recruited by a convenient sampling method. Body composition, nutrient intake, blood pressure and physical activity level were assessed. Independent t-test was used to compare pre and post-menopausal groups. Odds ratios were calculated to predict the risk of elevated blood pressure and central obesity. One sample t-test was used to compare current dietary intake of post-menopausal women with their Recommended Dietary Allowances (RDA). Mean Systolic and Diastolic blood pressure, waist circumference, waist to hip ratio, and fat mass were significantly higher in post-menopausal women compared to pre-menopausal women ( $p < 0.05$ ). Odds Ratio (OR) for elevated systolic blood pressure and diastolic blood pressure was 4.3 (95% CI 2.4-7.4  $p < 0.05$ ) and 2.7 (95%CI 1.5-4.9  $p < 0.05$ ), respectively in post-menopausal women compared to pre-menopausal women. OR for increased waist circumference was 2.6 (95%CI 1.4-4.9  $p < 0.05$ ) in post-menopausal women. Both pre and post-menopausal women had a significantly higher mean intake of saturated fat than RDA ( $p < 0.05$ ). Prevalence of cardiovascular risk factors was higher among post-menopausal women compared to pre-menopausal women. Post-menopausal women had significantly higher odds of having elevated blood pressure and central obesity which are strong risk factors for CVD.

**Keywords:** Cardiovascular risk, Menopausal status, Post-menopause, Pre-menopause, Risk factor

*Ethical approval has been granted to conduct this research by Ethical Review Committee, Wayamba University of Sri Lanka (Application No – 201907H106).*

## Poster Communications

### Development of a new equation for prediction of resting metabolic rate in Sri Lankan adults

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Resting metabolic rate (RMR) is a key determinant of daily energy requirement. Facilities for the measurement of RMR by indirect calorimetry (IC), (reference method) may not be accessible in routine settings. Existing RMR prediction equations were found to be inaccurate in Sri Lankans. Therefore, development of a new population-specific equation was important. Study objective was to develop a new RMR equation for healthy Sri Lankans using a reference method, IC. Anthropometric measures and RMR data from fifty seven (male 27 and female 30) apparently healthy individuals aged between 19 and 60 years were used. RMR was measured by Fitmate GS system (COSMED, Italy). New equation was developed using step-wise regression analysis based on the independent variables. Accuracy of the developed equation was assessed by paired t-test and Bland-Altman analysis. Age, BMI and RMR (mean±SD) were 34.9±13.0 years, 23.7±2.9 kg/m<sup>2</sup> and 1169.6±184.6 kcal/day. Step-wise regression analysis resulted in the following equation ( $R^2=0.89$ ): RMR (kcal/day) = 338.3 + (12.4 x weight) + (120.6 x Gender). (Note: Gender; male=1, Female=0). Paired t-tests resulted in no significant differences ( $p>0.05$ ) between predicted (1169.7±164.0 kcal/day) and measured (1169.7±184.6 kcal/day) RMR values. Bland-Altman analysis showed a strong agreement with mean bias less than 0.001±84.80 and bias was not significantly correlated ( $r^2=0.21$ ) with mean RMR measured and RMR predicted. For the first time in Sri Lanka a RMR equation was developed and this equation can be used to predict RMR and to design safe and effective energy balance programs for Sri Lankan adults.

**Keywords:** Resting metabolic rate, indirect calorimetry, reference method, prediction equation, Sri Lankans

*Study protocol (EC-18-068) approved by ethics review committee of the Faculty of Medicine, University of Colombo. The COSMED Fitmate desktop indirect calorimeter was obtained through a Technical corporation (TC) grant of the International Atomic Energy Agency (SLR/0635).*



## **Knowledge on diet and nutrition among a group of national-level athletes**

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Nutrition knowledge is a modifiable determinant of dietary behaviour and practices which are known to influence the performances in sport. The aim of the survey was to find out the knowledge on diet and nutrition in a group of national-level athletes participated for an educational programme. Before the educational programme the knowledge of the participants regarding diet and nutrition was evaluated using an anonymous questionnaire. The questionnaire consisted of a set of questions designed specifically to test the important aspects of basic knowledge on diet and nutrition. A score was created using 15 basic questions (total score = 15). Descriptive statistics were used in the analysis. Survey included 152 participants with 71(46.7%) males and 81(53.3%) females. Mean age was 26±6 years. Among them 63 (41.4%) had participated for education programmes on nutrition and 75 (49.3%) had visited a dietician or a nutritionist. Out of them 143 (94.0%) believed that proper nutrition is important for good performances. 40 (26.3%) were aware about the presence of five main types of nutrients, 13 (8.5%) knew about the presence of six main food groups and 81(53.2%) participants were aware of the presence of Food Based Dietary Guidelines for Sri Lankans. 11 (7.2 %) and 16 (10.53%) of them had consumed supplements and sport drinks respectively. Mean knowledge score was 9.0(±2.4) based on the responses to the 15 questions and there were 37 (24.3 %) participants below the average of 7.5. Knowledge on important areas of diet and nutrition is low among national-level athletes while the mean score was satisfactory. Consumption of dietary supplements and sport drinks is at a low rate.

**Keywords:** Diet, knowledge, national-level athletes, nutrition

*Ethical consideration is not applicable. This is based on anonymous data obtained at an educational programme to improve the programme*

## **Challenges and potentials in implementing food-based dietary guidelines through school curriculum and in school environment**

**IHCR Hewage and KDRR Silva**

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Food-based dietary guidelines (FBDGs) is one of the communication tools in school-based nutrition education, developed to provide knowledge on balanced diet and healthy lifestyle. School curriculum and school environment should facilitate the implementation of FBDGs. The objective of the presents study was to investigate the teachers' opinion of challenges and potentials of school curriculum and school environment in implementing FBDGs. A descriptive cross-sectional study was conducted using 167 teachers who taught food and nutrition related subjects with at least 2 years of teaching experience, selected from 90 secondary schools of 4 education zones in Gampaha, Kurunegala and Kalutara districts. A self-administered questionnaire was used to collect data. The content of each subject in secondary school curricula was mapped against 17 FBDG. Major topics identified by the teachers in curricula were balanced diet, healthy eating patterns, nutrients in foods, nutrient requirements in different stages of the life cycle and food groups and their importance to body functions. Major challenges found in implementation of FBDGs in the schools were insufficient practical guidance, insufficient time, lack of healthy food service programme and fast foods outlets near schools. Availability of adequate sanitary facilities was identified as the major potential factor. Health and Physical Education subject is the major subject providing knowledge on FBDGs. All FBDGs are addressed in the secondary school curriculum when several subjects are considered together although the term 'FBDG' was not specifically mentioned. Overall, the school environment is conducive in implementing FBDGs although there were some barriers and challenges.

**Keywords:** Challenges, food based dietary guidelines, nutrition education, potentials, school curriculum and environment

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka*

## **Eating behaviours and attitudes towards eating among allied health undergraduates in Sri Lanka**

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Young adults who got transition in to university life change their eating behaviours largely due to lack of time, stress and heavy work load. The aim of this study is to assess the eating behaviours and attitudes towards eating among the allied health undergraduates of a defence university. A descriptive cross sectional study was carried among 238 allied health undergraduates using a pre-tested self-administered questionnaire and systematic random sampling method was used. One hundred and eighty five 77.7% (185) participants were having regular meals, 22.3% (53) were on irregular meals and 72.3% (172) had skipped their meal at least once during previous week. Further, 16% (38) were snaking instead of main meal and nearly 29% (69) were used to snaking between main meals daily. Of the sample 38.7% (92) ate green and yellow colored vegetables daily and 11.8% (28) ate fruits daily. The Mean score of overall eating habits was 14 (Scale: 0-29) with 52.9% of the participants scored below the mean. More than half of the participants stated that they enjoy new foods(95.4%), love foods(93.3%), eating more when angry(71%), enjoy eating(67.6%), eating more when worried (61.3%), feel hungry when having foods with them(53.8%), eating when bored(50.4%) and eating when happy(53.8%). The mean score of attitudes towards eating was 28.43(scale:12-36) with 51.3% scored above mean. The eating behaviours of participants were not satisfactory. The overall attitudes towards eating were positive. Increase in awareness on eating behaviours is justified to improve eating behaviours among the study population.

**Keywords:** Eating habits, psychological factors, allied health undergraduates

*Study protocol was approved by the Ethical Review Committee of Faculty of Medicine, General Sir John Kotelawala Defence University.*

## **Changing patterns in food and nutrient supply for Sri Lankans from 1961 to 2017**

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Identification of specific changes occurred in the food consumption is important to investigate whether the country's food supply adequately meet the nutritional requirements of the population, and the way that changes in composition of the diet's influence on growing trends of nutrition problems. The objective of this study was to analyze the food balance sheets of Sri Lanka from 1961 to 2017 to track the changes occurred in food, per capita energy and nutrient supply in the country. Food balance sheets published by Food and Agriculture Organization from 1961 to 2017 were analyzed for trends in supply of foods, and energy and nutrient availability was estimated. Of the cereals, rice (244 g/day in 2017) is the main source for calories, carbohydrate and protein. Per capita supply of energy, carbohydrate and protein have increased over the years from 1961 to 2017. Calories derived from protein (12.6% from total energy), per capita supply of fruit and vegetables (480 g/day), and the nutrients – iron (15.3 mg/day), folate (244 µg/day), vitamin B<sub>12</sub> (0.21 µg/day) and vitamin A (704 µg/day) were well below the WHO recommendations in almost all years. Per capita supply of animal food sources showed an increasing trend. Per capita supply of sugar and alcohol had an increasing trend over the recent years. In conclusion, the analysis showed inadequate supply of several nutritious foods such as pulses, fruits and vegetables and animal food sources whereas supply of cereals was adequate. The results suggested need of nutritious food supply to achieve a healthy diet for Sri Lankans.

**Keywords:** Food balance sheets, food consumption patterns, non-communicable diseases, nutrient availability

## Free sugar intake and correlated factors among preschool children in the district of Colombo

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Excess free sugar intake has many adverse health outcomes, predominantly dental caries and weight gain in children. To tackle these, sugar intake and correlated factors needed to be identified. To assess free sugar intake and correlated factors among preschool children in Colombo district. A sample of 813 preschool children aged 36-71 months were selected using probability proportionate to size technique and cluster sampling. A food frequency questionnaire was developed, validated and used to assess free sugar intake. A pretested questionnaire, administered to caregivers, was used to collect data on factors correlating to free sugar intake. Median (IQR) amount of free sugar intake was 57.9 (33.2 -95.8) g/ day which was 21.1% (12.5% -35.9%) of their total energy requirement. This is four fold greater than WHO recommendation to limit sugar intake less than 5% of total energy intake, and 96.3% children consumed sugar above this level. Sugar intake significantly reduced with increased maternal education level ( $p=0.04$ ). A higher sugar intake was noted among those who ate while coming back from preschools ( $p<0.001$ ), while watching television ( $p<0.001$ ) and who had school going siblings ( $p=0.02$ ). Children of other ethnicities eat more sugar than Sinhala children ( $p= 0.01$ ). Under weight children were taking high percentage of their energy requirement from free sugar than normal or overweight children. The alarmingly high sugar intake associated with poor eating behaviour and maternal education highlight the need for urgent measures to curtail the sugar intake among children.

**Keywords:** Free sugar intake, correlated factors, WHO sugar guideline, Preschool children

*Ethical clearance was obtained from the Ethics Review Committee, Faculty of Medicine, University of Colombo. No funding.*

## **Effect of low-calorie diet on management of type 2 diabetes mellitus**

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Type 2 diabetes mellitus (T2DM) is a major burden to the health-care system and prevalence of diabetes is rapidly increasing, therefore, novel approach in management is needed. Lifestyle management has a greater effect on T2DM. Diet and physical activity plays a major role. This quasi-experimental study was aimed to evaluate the effect of a low-calorie diet (LCD) on anthropometric and biochemical parameter of T2DM patients and to investigate the compliance of study. A total of 35 T2DM participants completed a 12-weeks LCD (n=11) and low-carbohydrate diet (n=24-control group), with the assessment of anthropometry, fasting blood tests, blood pressure and 24-hour recalls at baseline and after 12-weeks. Paired t-test was done within groups and independent t-test was done between groups.

The results showed no significant difference in anthropometric and biochemical parameters within the LCD group at baseline and 12-week except high-density lipoprotein (HDL) and total cholesterol and the 24-hour energy consumption remains significantly unchanged and it indicated noncompliance of participants toward intervention. Dietary analysis resulted that there was no significant changes in the macronutrient composition in average. A comparison of two diets showed no considerable benefits on diabetic patients and it was due to the poor compliance to the both interventions. Study did not provide sufficient evidence to evaluate the effectiveness of dietary intervention by comparison of two dietary programs used in the study. Further extended studies using alternative dietary intervention trials are recommended.

**Keywords:** Dietary intervention, low- calorie diet, Quasi-experimental, Sri Lanka, type 2 diabetes.

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka*

*Wayamba University Research Grant Scheme 2019 is acknowledged.*

## **Dietetic behavior of people with type 2 diabetes mellitus**

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Diabetes mellitus (DM) is one of the most prevalent metabolic diseases in the world as well as in Sri Lanka. Diet plays an important role in diabetic management among type 2 diabetic patients. The objective was to find out the association between dietary behavior and diabetic management among a selected sample of diabetic patients. A cross sectional study of thirty (n=30, male=08, Female=22) type 2 diabetic patients who attended Non Communicable Disease (NCD) clinics in Kurunegala District were recruited to the study. An interviewer administered General questionnaire was used in data collection including information on demographic, sociodemographic and biochemical. A Food Frequency Questionnaire was used to obtain diet history. American Diabetes Association recommended fasting blood glucose level for type 2 diabetes patients was used to classify the study sample as glycemic controllers and non-controllers. Dietary data was analyzed using Food Base 2000. SPSS 16.0 software, Chi-square test was used to find out association between different factors ( $P < 0.05$ ). The mean fasting blood sugar level of the study sample was 181.16 mg/dl and 70% (n=21) of the sample was diabetic non-controllers and 30% (n=7) was controllers. Mean energy intake of the study population was 1881.67 kcal/day. Mean carbohydrate intake of the population was higher (64.39%), mean protein intake was lower (09.97%). Contribution of fat (25.28%) is in the recommended level. Carbohydrate intake had showed significant association with diabetic patients who hasn't control their blood glucose level. It can be concluded high carbohydrate consumption is negatively affected with the diabetic management of the study sample.

**Keywords:** Carbohydrate consumption, Dietary behavior, Glycemic control level, Nutrient intake, Type 2 diabetes

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka*

*Wayamba University Research Grant Scheme 2019 is acknowledged.*

## **The level of adherence: school canteen policy and guidelines by the schools in Southern Province**

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There are limited studies on identifying the success of the implementation of the school canteen policy and guidelines in Sri Lanka. This study was aimed to determine the adherence level of the school canteen policy and guidelines by the schools in Southern Province. The schools in Southern Province were selected using simple random and stratified sampling methods. An interviewer administered questionnaire and direct observations of the canteen were used as the data collection techniques. To determine the adherence to the ten policy criteria and guidelines, a scoring system (scale ranged 0-100) was developed. Each policy was given maximum ten scores. According to the obtaining scores, adherence was categorized into five categories; 0-20 not adhere; 20.1-40 poorly adhere; 40.1-60 slightly adhere; 60.1-80 moderately adhere and 80.1-100 strongly adhere. Out of total 56 schools, only 33 (59%) schools had a canteen and 29 (88%) schools had a school canteen committee to monitor the canteen. Results showed that only 1 (3%) school strongly adhered and 14 (42%) schools did not adhere the school canteen policy and guidelines. The least adhering policy criteria by the studied schools were 'ascertain the cleanness of utensils' and 'ascertain food safety and appropriate nutritional value'. Availability of 'unhealthy' foods in the canteen and availability of food stalls around the school were major identified barriers for not adhering to the school canteen policy and guidelines. The necessity of the proper mechanism to monitor the adherence of the school canteen policy and guidelines at the schools is proved the results of this study.

**Keywords:** adherence, guidelines, policy, school canteen

*Permission was obtained from relevant authorities. Prior to data collection, the study is briefly explained to principals of selected schools and only willing to participate principals' written consent was obtained.*



## **Perceptions of secondary school teachers on food and nutrition education**

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The secondary school-based food and nutrition education helps to establish healthy eating habits among adolescents. There is a lack of research evidence regarding the barriers and opportunities associated with this form of education in Sri Lanka. This study was done to explore the teachers' opinions of challenges and opportunities associated with secondary school food and nutrition education. Twenty-five home science, science, health and physical education, agriculture and practical and technical studies teachers were recruited from Giriulla and Kuliypitiya education zones. They were interviewed using an interview guide with ten explainable questions and associated probing questions. Interview audio records were transcribed, and the transcripts were translated into English. The translated transcripts were uploaded to N-Vivo qualitative data management software and analyzed using the template analysis technique. Based on the teachers' opinions the main challenges were: need for changes in food and nutrition curricula; the influences of internal and external food environment on food and nutrition education; concerns regarding the time allocation for food and nutrition education; need for more teacher training programmes; and problems associated with the practical application of food and nutrition education. The main opportunity was the supportiveness of school management in the delivery of food and nutrition education. The findings suggest that there are many challenges associated with food and nutrition education in secondary school settings. Addressing these challenges is necessary to improve this form of education. The identified opportunities should be used in school food and nutrition education enhancement efforts.

**Keywords:** Food and nutrition education, secondary schools, teachers, perceptions, interviews

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka*

## **Conventional low-calorie diet for managing adult obesity**

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Obesity is considered a major cause of co-morbidities associated with mortality and morbidity. It can be managed via dietary interventions, behavioral changes, surgical treatments, and pharmacological treatments. Dietary intervention is a major part of weight loss therapy. It has been proven beneficial effects of weight loss by 5 % from baseline weight. However, limited studies are available locally. The objective was to determine the effectiveness of a 12-week conventional low-calorie diet intervention on body weight, body composition, and metabolic parameters. Following a preliminary screening 10 obese adults (BMI  $27 \pm 4.12$ ) aged with  $56 \pm 9.34$  were recruited from three ongoing clinics in Kurunegala district. The study was a quasi-experimental design. The diet plans were based on 30kcal /day/weight and calorie deficit according to the obese category of each participant. Body composition, fasting glucose, lipid profile and blood pressure were measured before and after the study. Dietary data were taken as 24 hr. recalls. Data analysis and dietary analysis were done using SPSS 16.0 and Food base 2000 software. Despite no change in body weight, there was a significant ( $p < 0.05$ ) reduction in body fat percentage. Further plasma LDL (low-density lipoprotein) has also significantly decreased. However, the plasma glucose level has been significantly increased. A conventional low-calorie dietary intervention does not show enough supportive evidence in managing metabolic parameters. Despite unchanged bodyweight the dietary program shows effectiveness towards losing body fat level. Further extended studies are recommended with modified study approaches on behavioral and dietary changes.

**Keywords:** Adults, Conventional, Low-calorie, Obesity

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka*

*Wayamba University Research Grant Scheme 2019 is acknowledged for funding*

## **High prevalence of sarcopenia is associated with protein intake in Sri Lankan older people**

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Sarcopenia prevalence increases with age and is of particular concern given the increasing global ageing population. Sarcopenia can lead to frailty, increased risk of falls and a loss of independence. Sri Lanka has the fastest growing elderly population (9.2% total population) in South East Asia. This cross-sectional study aimed to assess the prevalence and association of sarcopenia with protein intake, in a Sri Lankan older population. A total of 200 subjects aged  $\geq 60$  years from free-living ( $n=100$ ) and care homes ( $n=100$ ) were recruited. Hand-grip muscle strength of the prominent hand was used to assess sarcopenia. Height, weight, mid upper arm and calf circumference were measured. Body composition was assessed using body analyzer scale. A 24-h dietary recall was used to determine the protein intake and dietary diversity. Prevalence of sarcopenia was 36% higher in institutionalized (89%) compared to free-living older adults (39%). A significant positive association between protein intake and sarcopenia ( $r=0.39$ ,  $p=0.001$ ) and fat-free mass ( $r=0.38$ ,  $p=0.001$ ) was found. Mean (SD) dietary diversity score was 7.3 (1.3) out of 12 food groups considered. In conclusion, both the quantity and quality of dietary protein was associated with a higher prevalence of sarcopenia, representing an urgent need for nutrition interventions for healthy ageing.

**Keywords:** Elderly, Hand-grip muscle strength, Lean mass, Protein intake, Sarcopenia

*Study protocol was approved by the Ethics Review Committee of Wayamba University of Sri Lanka (Application No: 201907H103).*

## **Effect of protein on mucous production on patients with respiratory tract infections**

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Increased protein consumption has a long history with worsening respiratory tract infections and its symptoms. Protein is a main ingredient in mucous. Excessive intake of protein may cause Goblet cell Hyperplasia which will result in increased production of mucus. Which will worsen the symptoms. But there is no solid evidences to be found on backing up this statement. Study was conducted in Tver region of Russian Federation in 2017. Main protein sources included red meat, milk and cheese. The main objective of the study was to assess the level the protein rich food worsens the respiratory tract infections. The study was conducted at the medical wards of the Tver regional hospital and data were collected within 3 months. Patients of age range of 20-40 y (50) who presented with respiratory tract infections ( RTI). Standardized questioner was used to assess consumption of protein rich food after initial symptoms. Subjects were divided to two groups composing of individuals with continuous consumption of protein rich foods (Group 1) and those who withheld consuming protein rich food (group 2). Patients were closely monitored at the hospital for worsening of symptoms. The results showed that group withheld consuming protein rich food had less severity of the illness than those of individuals with continuous consumption of protein rich foods Number of nebulization episodes and hospitalization period was higher in group 1 than that of 2. Protein rich foods may affect the mucous production during RTI. Future research are warranted with increased sample number.

**Keywords:** Protein, respiratory tract infections, worsening symptoms, mucous

*Permission has been taken from the Tver state medical university to conduct the research at a public hospital and a written consent from participants to take part in the research and not to disclose their personal information.*

## **Dietary menus for pre-dialysis patients with chronic kidney disease**

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Chronic Kidney Disease (CKD) is defined as either renal damage or decreased renal function for three or more months. Since nutrition plays a major role in management of CKD this study was conducted to develop healthy dietary menus for pre-dialysis CKD patients. A preliminary survey was conducted at Teaching Hospital, Batticaloa to identify the patients' food preferences, dietary patterns and nutrient intake. Dietary menus were developed including appropriate foods with portions to full fill the dietary guidelines for pre-dialysis CKD patients. The major concerning nutrients for developing menus were calorie (30–35 kcal/kg/IBW/day), protein (0.75g/kg/IBW/day), fat (30% of calorie), sodium (1.8–2.5 g/day), potassium (1.5–2 g/day) and phosphorus (600–1000 mg/day). Developed dietary menus' nutrition composition was analysed by FoodBased 2000 software. Findings showed that all (30) patients were non-vegetarian, 56.7% of them preferred to eat animal based protein sources and their fruit and vegetable consumption varies with the seasonality and availability. Although the mean intake of energy of males ( $1184.667 \pm 436.18$  Kcal/day) and females ( $932.1667 \pm 191.353$  kcal/day) were lower the sodium intake was within the recommendations for CKD patients in pre-dialysis stage. The developed menus given total energy ranged from 1700 to 2300 kcal/day by increasing 100 kcal/day. The menus were developed by incorporating available and preference foods of the study group. The developed menus were compiled as a booklet and nutrient compositions of menus per day also included in the booklet. The developed menus may be a good attempt to manage the disease of pre-dialysis patients.

**Keywords:** CKD, dietary menus, patients, pre-dialysis, renal function

*Permission was obtained from the health authority prior to the study and written consents were collected from the participants who were willing to participate the study after briefing the study.*

## **An approach to provide healthy meals by developing rating system for restaurants and eateries in Sri Lanka**

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Eaters from restaurants and eateries have more chance to have Non- Communicable Diseases (NCDs) and food-borne illness due to meals higher with energy and fats and improper storage, food handling and preparation practices. Hence this study was conducted as an approach to provide healthy meals for out-home eaters by developing a healthy meal rating system for restaurants and eateries in Sri Lanka. Firstly, available meals rating systems and their rating criteria were collected through the reviewing the literature and conducting a preliminary survey among restaurants and eateries in Sri Lanka. A meal rating system was developed by considering the food hygienic and health aspects of meals and presented as a checklist with scores. According to the obtaining scores for each and every food hygiene and healthiness aspects of the meals, 1 to 3-star rating criteria was developed to rate the restaurants and eateries. The developed rating system was name as “Healthy Meal Rating Guide” and presented as a booklet by including all the information. By using the draft version of the guide 10 restaurants were evaluated to identify the drawbacks of the developed rating system and the final version was developed by addressing the comments received from the pre-testing. Twenty-five restaurants were rated according to the developed rating criteria, it showed that 8% of restaurants were in 3-stars, 40% in 2-stars, 28% in 1-star and 24% were not in any star category. The developed rating system may be a useful guide to provide healthy meals for out-eaters in Sri Lanka.

**Keywords:** Eateries, healthy meals, outlets, rating systems, restaurants

## **Adherence to infant and young child feeding guidelines**

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Infant and young child feeding guidelines were issued by the Family Health Bureau of the Ministry of Healthcare and Nutrition with the view of improving nutritional status of the infants and children who will be the future of Sri Lanka. This study aims to assess the adherence to infant and young child feeding guidelines by mothers of infants and young children aged between 6 – 24 months. A cross sectional study followed by stratified random sampling method was conducted in Jaffna, Vavuniya, Batticaloa and Ampara districts. A total of 140 mothers were recruited for this study. A pre-tested interviewer administrated questionnaire was used to obtain socio-demographic information and information regarding infant and young child feeding guidelines. Dietary intake of infants and young children from different food groups was obtained from 24-hour dietary recalls. Adherence to guidelines was measured by using 17 dietary guidelines (scale: 0–17;  $\leq 7$ : non-adherence and  $\geq 8$ : adherence). The mean age of the study sample (mothers) was 31 (SD 3) years. Majority of the mothers (96%) were followers of the feeding guidelines and among them 65% of mothers adhered to 10 guidelines out of 17. However, lowest adherence (2.9%) was showed for giving extra meal during illnesses. Further, results revealed that adherence was positively correlated with educational level of mother ( $r=0.167$ ), monthly income of the family( $r=0.209$ ) and monthly expenditure for food ( $r=0.246$ ). The findings of the research showed the necessity of awareness programs on infant and young child feeding guidelines for mothers at Maternal and Child Health Clinics.

**Keywords:** Feeding guidelines, infants, mothers, young child

*Permission was obtained from relevant authorities. Prior to data collection, the study was briefly explained to mothers and only willing to participate mothers' written consent was obtained.*

## **Development and evaluation of electronic nutrition course for secondary school students in Sri Lanka**

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Nutrition education helps adolescents to establish healthy eating habits by giving them knowledge and skills necessary to make healthy food choices. Computer-tailored nutrition education courses are effective in providing nutrition education. The purpose of this study was to design an electronic nutrition course suitable for Sri Lankan secondary school adolescents and explore the students' and teachers' opinions about it. In phase one the course was developed. The focus area of this course was set as healthy dietary habits. First, learning outcomes of the course were formulated considering the previous literature and current school food and nutrition-related subject matters. Twelve units were created to achieve the learning outcomes and contents and activities were developed for each unit. After several iterations, the course contents were finalized and transferred to an electronic version. In phase two, the opinions of 10 teachers and grade 8-10 students regarding the course were obtained through face-to-face interviews. The respondents were recruited using the convenience sampling approach. The recorded interviews were analyzed manually to identify the general opinions of the participants. Teachers appreciated the course and suggested to include new topics such as Sri Lankan traditional meals and the contribution of foods in prevention of non-communicable diseases, etc. Students revealed they got knowledge about healthy dietary habits in an attractive manner through this course. This electronic nutrition course can be used as a complementary education tool in secondary school food and nutrition education.

**Keywords:** Adolescents, dietary habits, electronic course, nutrition education, secondary schools

*Financial support for this project was provided by the Department of Applied Nutrition, Wayamba University of Sri Lanka.*



## **Nutrient extracted fruit reduces postprandial blood glucose response**

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Fruits are abundant source of vitamins, minerals, antioxidants and fibre. However, it is believed that certain fruits and fruit juices tend to increase the postprandial blood glucose levels. This study aimed to compare the postprandial glycaemic response and glycaemic glucose equivalence (GGE) over 2 hours of homogenized nutrient extracted fruit with its whole fruit counterpart and a glucose control. This study was conducted as a randomized controlled crossover study with healthy subjects (n=12) aged between 20-25 years ( $23\pm 1$ ). Subjects were assigned to five test fruits: watermelon whole fruit, nutrient extracted watermelon, pineapple whole fruit, nutrient extracted pineapple and glucose. In an acute study day, blood was taken at time intervals of fasting, 15, 30, 45, 60, 90 and 120 minutes after consuming each treatment using a glucometer. Glycaemic Index (GI) and GGE were calculated. GGE values were calculated from the measurements of the incremental area under the curve for the test fruits per 100g. Consumption of nutrient extracted watermelon resulted in a significant lowering of the GI (31, SEM 6.0) compared with whole fruit (56, SEM 12.2). Consumption of nutrient extracted pineapple resulted in a significantly lowering of the GI (48, SEM 7.7) compared to whole fruit (83, SEM 10.1). Resulted GGE values for watermelon whole fruit, nutrient extracted watermelon, pineapple whole fruit and nutrient extracted pineapple were 2.8, 2.1, 8.3 and 6.2 GGE/100g, respectively. In conclusion, nutrient extraction elicits much favourable postprandial glycaemic response than whole fruit. The mechanism responsible for this effect is not yet identified. These results suggest that fruit prepared by nutrient-extraction could be considered as a potential glycaemic control strategy.

**Keywords:** Glycemic glucose equivalent, glycemic Impact, glycemic Index, nutrient extracted fruit, postprandial glycemic response

*Ethical clearance was obtained from the Ethics Review Committee of Wayamba University of Sri Lanka (Application No: 201907HI05)*

## **Effect of low versus high glycaemic index breakfast on satiety and subsequent food intake among obese subjects**

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Obesity is becoming an increasing health problem. It is a major burden for healthcare costs because it is related to many chronic diseases. Therefore, simple strategies to regulate food intake have increasingly become an area of interest. This study investigated the impact of a low glycaemic index (LGI) breakfast with a high glycaemic index (HGI) breakfast on glycaemic response over 2 hours, satiety over 3 hours and subsequent food intake over rest of the day among obese subjects. A randomized, cross-over, postprandial study was conducted in 12 obese subjects [mean  $\pm$  SEM;  $24 \pm 0.4$  y; mean  $\pm$  SEM body mass index ( $\text{kg}/\text{m}^2$ );  $29.0 \pm 0.9$ ]. After fasting overnight, participants consumed iso-caloric test meals with HGI (GI=77) or LGI (GI=44) on separate occasions each 3 days apart. Satiety was self-reported using a visual analogue scale and plasma glucose concentrations were measured. Dietary intakes were assessed using a 24hr food diary. The incremental area under the curve for glycaemic response was lower after the LGI meals than after the HGI meals (mean  $\pm$  SEM:  $1653.8 \pm 270.5$  compared with  $3531.9 \pm 454.1$   $\text{mg}/\text{dL} \times \text{min}$ ;  $P < 0.000$ ). The LGI breakfast elicited significantly higher level of satiety than the HGI breakfast ( $P = 0.0001$ ). Subsequent food intake did not differ between the test meals. Our study showed a differential impact of meal glycaemic index on glycaemic response and subjective satiety, however no effect on subsequent food intake in obese subjects.

**Keywords:** Glycaemic index, glycaemic response, meal, obesity, satiety

*A favorable ethical opinion for the conduct of this study was given by the ethics review committee, Wayamba University of Sri Lanka (Application no: 201907HI04).*

## **A ready to serve green leafy porridge for adults in Sri Lanka**

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Green leafy porridges are unique traditional semi solid food in the Sri Lankan food culture. They have been used as a remedy for overcoming a number of ailments and are used as every day breakfast food by many people in the population. However traditional preparation method consumes a considerable time. This study was aimed to develop a canned ready to serve green leafy porridge with low glycemic index and glycemic load. Ingredients used were Asiatic Pennywort leaves (*Centella asiatica*), ginger roots (*Zingiber officinale*), garlic cloves (*Allium sativum*), rice whole grains (*Oryza sativa*) and salt. Cleaned ingredients were chopped and blended while cooking using a commercial cooking blender followed by canning and retorted under 121<sup>o</sup>C temperature and 15 psi pressure. Three recipes were developed and each was subjected to sensory evaluation. Friedman's statistical analysis was done using SPSS 16.0 and best canned herbal porridge recipe was selected. Estimated composition for a serving of the canned porridge (300mL) was, carbohydrate 14.5g, protein 2.4g, fat 4.9g, fiber 3.6g and the energy content 438.84kJ. Moisture and ash contents were 91 and 0.6% respectively. Porridge showed a low glycemic index (GI) and low glycemic load (GL) values. GI of the product was 40 and the GL was 6 (n=10). Porridge has a higher satiety level compared to the common rice porridge (n=6). Conventional green leafy porridge is capable of producing to an organoleptically acceptable canned instant herbal porridge. *Centella asiatica* based herbal porridges are more palatable and show higher fulfilling effect. Developed ready to serve green leafy porridge is warranted as a healthy instant meal option, convenient to use by any adult population.

**Keywords:** Canned Herbal Porridge, *Centella asiatica*, Low Glycemic Index, Ready to Serve

## **Why do not eat right quantity of fruits and vegetables in Sri Lanka ?**

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Sri Lankans do not consume the recommended amount of fruits and vegetables. Adequate fruit and vegetable *consumption* is vital to prevent and reduce the risk for non-communicable diseases and micro nutrient deficiencies. This study aims to determine the degree of consumer level problems for right quantity consumption and identify the barriers at production, distribution, storage of fruits and vegetables. Interviewer based questionnaire was used to identify the degree of consumer level barriers. Secondary information were used to identify barriers at production, distribution and storage. Hundred consumers completed a survey in Kurunegala district. Information on demographics, socioeconomic, barriers to fruits and vegetable consumption and frequency of fruit and vegetable consumption were collected. Secondary information were used to analyze the changes occur in growing land areas, annual production fluctuations, post-harvest losses during the transportation, climatic condition and to calculate the logistic expenses namely labour, irrigation, fertilizer and transport costs for fruit and vegetable cultivation. The consumer level barriers to fruit and vegetable consumption were the high cost (40%), lack of market place (21%), family/ peer/ society influences (16%) and poor availability (15%) in Kurunegala District. Poor improvement in the growing land areas, high post-harvest losses during the transportation, decreasing trend in number of rainy days and the widens price gap between the growers and consumers were main barriers at production, distribution, storage and marketing of fruits and vegetables. In conclusion barriers at consumer level as well as production, distribution, storage and marketing levels needs to be addressed to correct right quantity consumption of fruits and vegetables in Sri Lanka.

**Keywords:** Barriers, consumers, Fruits and vegetables, Kurunegala,

## **Acute effect of herbal tea on glycemic response in healthy and hyperglycemic individuals**

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High prevalence of diabetes mellitus (DM) characterised by hyperglycemia, has led to a concurrent increase in the usage of herbal teas to treat diabetes due to their hypoglycemic property, natural origin, free availability and lesser side effects. The study was aimed to determine the acute effect of herbal tea prepared from *Cassia auriculata* buds and flowers and *Artocarpus heterophyllus* leaves on glycemic response in healthy and hyperglycemic individuals with two types of carbohydrate load meals. A total of 34 subjects were recruited and categorized into 3 groups. On the first visit, 13 healthy (1<sup>st</sup> group), 12 healthy (2<sup>nd</sup> group) individuals and 9 hyperglycemic individuals (3<sup>rd</sup> group) were given 50g, 25g and 25g carbohydrate load meals respectively. On the second visit they were given same meal with herbal tea. Their plasma glucose concentration was obtained over 2 hours with different time intervals (fasting, 30, 45, 60, 90 and 120min). Glycemic responses were calculated using incremental area under the curve (IAUC) and paired t test and independent sample t test were done using SPSS software. The mean plasma glucose concentration of healthy individuals with 25g carbohydrate load showed a significant ( $p < 0.05$ ) difference with and without the herbal tea. A significant ( $p > 0.05$ ) difference was not observed for the healthy group with 50g of carbohydrate load and hyperglycemic group. The herbal tea showed 42.75%  $\alpha$ -amylase inhibitory activity. The study concludes that the herbal tea has acute hypoglycemic effect in healthy individuals but effectiveness vary with the carbohydrate load.

**Keywords:** *Artocarpus heterophyllus*, *Cassia auriculata*, diabetes mellitus,  $\alpha$ -amylase

## **The Direct Cost of Diabetic Mellitus measurements in Kandy District, Sri Lanka**

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About 347 million people worldwide have Diabetic Mellitus (DM). In countries of the South Asian region the average number of DM is 78 million. Approximately 80% of DM patients live in low or middle income countries like Sri Lanka. In every 10 seconds there is a new case of DM detected in Sri Lanka. The prevalence rate of diabetes in an adult (20-79 years) is 8.5%. According to the data from Diabetes Association of Sri Lanka, (2011) there is a significant change among rural and urban population. There were 1.16 million cases of diabetes in Sri Lanka in 2015 and the number of deaths in adults due to DM was 16318. Number of hospitalization due to DM and its complications are increasing dramatically. In 1990s, the number of daily hospitalization was around 500 to 550. However, today it has increased to a figure around 1300 per day. In 2015 Sri Lankan government has spent 144.6 US\$ per one person with DM. A study about developing a program to measure the cost of illness (DM), which further enables to minimize the DM relative costs in any country. In health economics, the cost-effectiveness assessment and different concepts can be used to determine the cost-effective threshold with a focus on a country like Sri Lanka. It is important to make proper assessments and to find concepts to reduce the health cost of DM. Cost of illness studies are used more often by policy makers, governmental and non-governmental organizations, researchers and pharmaceutical companies. Objectives of this study were to measure the costs of illness (COI) in DM and to estimate the direct cost of DM in the central province. There are two types of costs and they are medical costs and non- medical costs. Medical costs include: cost for consultation, investigation and drugs. The total annual cost of government hospitals in Kandy district in 2018 was LKR 142085548.00. This amount contains three categories of annual cost for DM drugs (LKR 73680143), annual cost for investigations (LKR 21445832.70) and annual cost for salaries (LKR 65693586.27). The cost of DM in hospitals which has inpatient facilities (Divisional Hospitals, District Base Hospitals and District General Hospitals) was LKR 125454145.60 and the hospitals which has only out patient facilities (Primary Medical care unit) was LKR 16631402.39. The direct medical cost of DM in Kandy district was 3,551,872.30 for 10000 DM patients.

**Keywords:** Diabetic Mellitus, direct cost, costs of illness, consultation, investigation

## Nutritional status of Sri Lankan elderly

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Elderly are those aged 60 years and over represent the fastest growing segment of the world population in developing and developed countries and Sri Lanka is not an exception. Undernutrition is a common problem among elderly persons and furthermore is multifaceted in the origin. The objective of the present study was to assess the nutritional status of elderly using mini nutritional assessment (MNA). Island wide study was conducted with 600 older adults consisting of male and females, representing main three ethnic groups in Sri Lanka. Free living and institutionalized elderly were included. Data were collected by trained nutrition graduates under the supervision of registered nutritionist. Socio demographic and health conditions were collected through a general questionnaire. According to malnutrition indicator score 55, 36 and 9% were at normal nutrition status, at risk of malnutrition and malnourished, respectively. About 66% of elderly viewed self as free of any nutritional problem and 85% fed themselves without any difficulty. However, about 11% did not consume two or more servings of fruits and vegetables. There is a significant association with age and weight loss of the people. Percentage of age lost was high in the oldest category of greater than 80 y of age. In conclusion almost 45% of elderly in Sri Lanka had low MNA scores indicating poor nutrition. Further studies are warranted to assess dietary intake of elderly and possible interventions to improve the nutritional status.

**Keywords:** Free living, institutionalized, MNA, malnutrition

*Ethical clearance was obtained from the Ethics Review Committee of Wayamba University of Sri Lanka.*

*Authors acknowledged the funds granted from the University's Global Challenge Research Fund Internal Pump Priming Fund (GCRF-IPPF) of University of Aberdeen.*



# **Nutrition Society of Sri Lanka 2020**