

ISSN 2386-1665
ISSN 2792-100X
(electronic)



CINEC

Academic Journal

Volume 6 Issue II 2023

CONTENTS

-
- 1). **Adverse Complications Of Usage Practice Of Face Mask During An Epidemic; Pilot Study On Sri Lankan Perspectives**

 - 2). **Antioxidant Capacity Variation Across Different Parts of *Allamanda cathartica* (Golden Trumpet) Plant**

 - 3). **A Study On Impact Of Green Supply Chain Management Practices On The Environmental Performance Of Apparel Industry In Sri Lanka**

 - 4). **A Study On The Barriers And Challenges For The Usage Of Active Transportation In Sri Lanka: A Way Forward Of The Transport System In Sri Lanka**

 - 5). **Colregs Misunderstood Or Ignored?**

 - 6). **Correlation Of BMI With Educational Stress By Psychometric Analysis Via Perceived Stressed Scale In Non-State University Students**

 - 7). **Effect Of Quarry Dust in Compaction Characteristics Of Loose Sandy Soil From A Local Paddy Field**

 - 8). **Evaluation Of Knowledge, Attitudes And Practices On Facial Skincare Routines And Cosmetic Products In Undergraduates Of Universities And Higher Educational Institutes In Western Province, Sri Lanka**
-

CINEC Campus (Pvt) Ltd, Millennium Drive, IT Park, Malabe, Sri Lanka

Phone: +9411 2413 500 Hotline: +9411 4486 400, +9411 2413 505,

Fax: +94112413 505, Email: info@cinec.edu, Maritime@cinec.edu

9). Factors Affecting The Supplier's Quality Of The Prishables Supply Chain; Special Reference To The Hotel Industey In Sri Lanka

10). Factors Affecting To Container Inventory Management (CIM) In Container Depots In Sri Lanka

11). Gypsy: AI-Powered Virtual Assistant for Windows OS

12). Preliminary Study On Evaluation Of Knowledge, Attitudes, And Practices (KPA) Of Pharmacy Workers On Generic Vs. Branded Medicine In Colombo District, Sri Lanka

13). Principles for Responsible Management Education (PRME) in Sri Lankan Business Schools: A Pathway to Sustainable Business Education

14). Social Media Use Of University Libraries In Sri Lanka: A Content Analysis

15). Systematic Review : Safety And Efficacy Comparison Of Laser Therapy With And Other Resurfacing Technology

Catalogue Page

CINEC Academic Journal .- Vol.6, Issue II (2023)-

Ed. Menik Hettihewa. – Malabe : CINEC Campus

ISSN 2386-1665

i.378.005 DDC 23

1. Education, Higher-Periodicals
2. Private universities and colleges – Periodicals



2792-100X



2386-1665

Information to the subscribers and notes to the authors and contributors appear on the back page of the journal

ISSN 2386-1665

ISSN 2792-100X (electronic)

©2021 CINEC ACADEMIC JOURNAL

All rights reserved

Printed by Infinity Printing Solutions Lanka,

CINEC ACADEMIC JOURNAL

CINEC academic journal is indexed, referred, peer reviewed open access journal publishing high quality papers on all aspects of higher education streams in Humanity and education, social sciences, business & management, engineering, information technology, health and medical sciences, maritime sciences and maritime engineering. All the articles submitted to the journal are scrutinized and peer reviewed by a registered external and internal reviewer panel approved by the editorial board.

Editor in Chief

Menik Hettihewa

Managing Editor

Poornika Sandamali

Co Editor

Capt. Harindra Perera

Editorial board members

Internal

Capt. Peshala Medagama

G.S. Samarakkodi

C.D. De Silve

D. Dhammearatchi

S. Siriwardane

K. Ratnayake

A. Dissanayake

S. Sankaranarayana

External

U. Vidanapathirana

K. A. P. Siddhisena

S.K. Hettihewa

Message of the Chief Editor

Dear Esteemed Scholars and Distinguished Readers,

It brings me great pleasure to address you on behalf of the CINEC Academic Journal (CAJ). As the Chief Editor, I am honored to guide a journal that has been a beacon of scholarly excellence for the past five years.

CINEC Academic Journal is a peer reviewed open access multidisciplinary journal, and the journal has not only withstood the test of time but has also flourished into a respected platform for CINEC undergraduates across all the Faculties and Department of the CINEC Campus, Distinguished academics, Researchers, and Intellectuals.

The journey we have undertaken has been marked by a commitment to quality research, rigorous peer review, and a dedication to advancing knowledge in diverse fields. It is with pride that I acknowledge the accreditation bestowed upon us by the National Science Foundation of Sri Lanka (NSF) a recognition of our unwavering pursuit of academic rigor. CAJ is also recognized and listed under the online publication platform of National Science Foundation. Please refer www.caj.sljol.info

While marking the publication journey of successful five years, we are reflecting on the collective intellectual voyage that has enriched our community and contributed meaningfully to the academic essence and I am honestly be happy with the past achievements and as Chief Editor, I would like to express my sincere appreciation and gratitude to distinguished authors who has entrusted us with their valuable research, to honorary reviewers who has provided constructive feedback, and to our readers who continually engage with and contribute to the scholarly discourse presented in our journal.

The heart of our journal beats with the passion for discovery and the dissemination of knowledge. The diverse range of topics covered in our issues is a testament to the multidisciplinary nature of the academic landscape we navigate across the field of Engineering, Science, Health Science, Management, Logistics, Supply Chain, Tourism and Hospitality, Law, Maritime Science, Maritime Technology, Marketing, English, Education, Information Technology, Aviation, and any other multidisciplinary area.

The scholar's research and insights are the lifeblood of our journal, and we eagerly anticipate the wealth of discoveries and contemporary knowledge that the future holds. The academic community is dynamic, and so too shall be our commitment to adapt, evolve, and lead in the pursuit of excellence.

We anticipate the future with a positive outlook and a steadfast commitment to the pursuit of scholarly achievement. Collectively, let us persist in the pursuit of further exploration, discovery, and the reevaluation of the limits of human comprehension.

Thank you.

Menik Hettihewa, MBBS PhD

The Chief Editor

CINEC Academic Journal

Senior Professor and the Dean, Faculty of Health Sciences

CINEC campus, Malabe Sri Lanka

Former Senior Chair Professor of Pharmacology and, Faculty of Medicine University of Ruhuna,
founder Technology Transfer Director University of Ruhuna Sri Lanka,

h Index 8, RG index, 20.7

<https://scholar.google.com/citations?user=qDaGiMoAAAAJ&hl=en>

ORCID ID - 0000-0001-7780-0290

Email: Menik.Hettihewa@cinec.edu

Message of the Managing Editor

Dear Scholars,

I am pleased to announce that Volume 06 Issue II of the CINEC Academic Journal is now accessible both online and in print. As the managing editor, I extend my sincere gratitude to all the authors, reviewers, and editorial team members for their valuable contributions and dedication throughout the publication process.

This issue of our peer-reviewed journal encompasses a diverse range of insightful research articles, case studies, literature reviews, and theoretical contributions in multidisciplinary fields such as engineering, health science, education, management, and diversified disciplines. Every contribution demonstrates the dedication to achieving high academic standards and fostering new ideas within our educational community.

I would like to express my appreciation to our esteemed reviewers for their meticulous review process, ensuring the quality and rigor of the published content. Their expertise and constructive feedback have been instrumental in maintaining the scholarly standards of our journal. The collective efforts of our authors and reviewers have enriched this volume with valuable insights, advancements, and perspectives that contribute to the ongoing discourse in our fields of study. On behalf of the editorial team, I extend congratulations to all the authors whose work has been selected for publication in this issue. Your contributions play a vital role in advancing knowledge and fostering dialogue within our scholarly community.

We look forward to continued collaboration and engagement in future issues of the CINEC Academic Journal.

Poornika Sandamali

Managing Editor

CINEC Academic Journal

CONTENTS

1. Adverse Complications Of Usage Practice Of Face Mask During An Epidemic; Pilot Study On Sri Lankan Perspectives.....01
Batagallage C.K.K., De Silva K.G.V., Hirunika L.L.M., Kalupahana N.T., Hettihewa L.M.
2. Antioxidant Capacity Variation Across Different Parts of Allamanda cathartica (Golden Trumpet) Plant.....08
Dissanayake D.M.W.L., Bandara J.M.V.R.J., Tennakoon T.M.S.A., Kavindhya I.S., Sandeepa K.D., Ratnayake W.M.K.M.
3. A Study On Impact Of Green Supply Chain Management Practices On The Environmental Performance Of Apparel Industry In Sri Lanka.....15
Herath P., Gunawardana A.
4. A Study On The Barriers And Challenges For The Usage Of Active Transportation In Sri Lanka: A Way Forward Of The Transport System In Sri Lanka.....22
Ranawake, J., Siriwardene, S.
5. Colregs Misunderstood Or Ignored?.....34
Sankaranarayana S., Wickramasinghe T.S.
6. Correlation Of BMI With Educational Stress By Psychometric Analysis Via Perceived 6 Stressed Scale In Non-State University students.....42
Gamage B.S., Deraniyagala N.G.I.A., Perera K.M.D., Aishwarya A.A.K., Perera P.A.P.N., Hettihewa L.M.
7. Effect Of Quarry Dust In Compaction Characteristics Of Loose Sandy Soil From A Local Paddy Field.....49
Senanayaka S. K. S. M. S. I., Diyes G.H.I., Walpita S.C.
8. Evaluation Of Knowledge, Attitudes And Practices On Facial Skincare Routines And Cosmetic Products In Undergraduates Of Universities And Higher Educational Institutes In Western Province, Sri Lanka.....54
Jayathilake H.P.U.V., Nikathenna H.M.L.S., Dharmapriya H.A.T., Wanniarachchi P.K., Handugala H.M.D., Amarasinghe S.S., Wanasinghe W.A.D.M., Ratnayake W.M.K.M.
9. Factors Affecting The Supplier's Quality Of The Perishables Supply Chain; Special Reference To The Hotel Industry In Sri Lanka.....64
Habaragamuwa D.I., De Silva C.D.
10. Factors Affecting To Container Inventory Management (CIM) In Container Depots In Sri Lanka.....71
Gunathilake K.A.K.M., Siriwardana S.

11. Gypsy: AI-Powered Virtual Assistant For Windows OS.....81
Madushan V.P.T., Gunasekara S.V.S., Fernando B.
12. Preliminary Study On Evaluation Of Knowledge, Attitudes And Practices (KAP) Of
Pharmacy Workers On Generic Vs. Branded Medicine In Colombo District, Sri Lanka.....87
*Dharmapriya H.A. T., Nikathenna H.M L.S., Jayasiri T. P. K., Mendis D.H.A.,
Ratnayake W.M.K.M.*
13. Principles for Responsible Management Education (PRME) in Sri Lankan Business Schools: A
Pathway to Sustainable Business Education.....94
Bishri R.
14. Social Media Use Of University Libraries In Sri Lanka: A Content Analysis.....104
De Silva, A.P.U.
15. Systematic Review: Safety And Efficacy Comparison Of Laser Therapy With And Other
Resurfacing Technology.....111
Hettihewa L.M.

Adverse Complications of Usage Practice of Face Mask During an Epidemic; Pilot Study on Sri Lankan Perspectives

Batagallage C.K.K¹, De Silva K.G.V¹, Hirunika L.L.M¹, Kalupahana N.T¹, Hettihewa L.M¹

¹Faculty of Health Sciences CINEC Campus, Millennium Drive, IT Park, Malabe, Sri Lanka

Menik.Hettihewa@cinec.edu

ABSTRACT

Accurate use of face mask (FM) is important for prevention of airborne diseases such as COVID 19, and it's related with rapid spread and many post-covid complications. Our group investigated the usage practice of different types of FM using web-based self-administered questionnaire which was validated in the health sector. Study was conducted in public of Sri Lanka. The questionnaire with 23 questions and 8 questions directed for assessing the usage pattern of facemasks. The study represented all the districts and 99% of participants had used the FM and out of that, 55% were females and 45% were males. 71% of participants were young, 17% middle-aged and rest (12%) of above 40 years. Further, 74% of participants who used FM are tertiary educators and the rest are from school education. 50% of them were KN95/N95 users, 40% were disposable surgical masks, 6% used reusable cloth masks and 4% of others. 85% of them had used all disposable FM. Out of them, 65% had reused it and 35% of them had not reused it. Participants who used reusable cloth-masks, 58% washed every time, 36% after several uses, 2% rarely washed and 4% never washed. Regarding using time, 30% uses < 1 hr, 32% for 1-3 hrs, 28% use 3-6 hrs 5% for 6-12 hrs, and 5% > 12 hrs. 95% of participants mentioned that they do proper disposal but only 35% practiced the correct method. Most of them had reused the disposable FM and also use cloth masks without rewashing. This pilot study showed that importance of dissemination of the knowledge on proper disposal of FM and recommended intermittent detailed health education program and disposal monitoring system in this regard.

Index Terms- *Face Mask, Usage Practice, Adverse Complications*

INTRODUCTION

Coronavirus 2 (SARS-CoV-2), disease is a severe acute respiratory syndrome caused by commonly known as COVID-19, and it became a pandemic causing millions of deaths all over the world despite the vaccination program initiated. In Sri Lanka, first case was reported on 15th of February 2020 as one patient and second patient were reported on 11th of March 2020 [1]. Numbers rapidly exceeded more than 1000 in October government made the country lock down to control the spread while arranging the vaccination program with Astrozenica [2]. Since the detection of the first COVID-19 case in from March 2020 up to September 21, there have been confirmed cases with 5,710 deaths [3,4,5]. Government implemented of practicing one meter distancing at everywhere and proper hand washing methods at every entrance to the premises have been strictly adopted at the beginning to reduce the transmission of COVID-19 in the community in Sri Lanka. Strict use of facemasks was also included in the national guidelines. Because community-wide covering of face to prevent transmission through infected saliva and respiratory droplets from individuals was thought to be helpful in control of this infection with subclinical or mild infections [6]. There is also evidence that many people are asymptomatic [7-10]. For example, studies in China and Italy have shown that 78% and 50–75% of people with positive molecular tests were completely asymptomatic [9,10]. Thus, wearing masks by asymptomatic individuals in public was earlier disputed and regarded as not being effective. However, there are great antithetical evidence that shows the use of face masks reduces the risks of COVID-19 transmission to a large degree [11–17].

Mandating face mask use in public is correlated with the daily reduction in COVID-19 transmission, which helps in mitigating the spread of the disease [12]. Despite the consistency in the recommendation for the use of face masks by the healthcare providers and symptomatic individuals, it is not recommended for

the general public and the wider community [18]. Nonetheless, public mask wearing is now highly advocated, particularly in areas in which there are high levels of community transmission. However, the use of face masks by healthy individuals in the community to reduce the risk of viral respiratory infections remains contentious.

The current available types of masks include medical masks, N95 masks, and non-medical cloth masks [19]. Medical masks are loosely fitted devices worn by the health care workers and infected individuals to reduce the transmission risk of contagious respiratory droplets between individuals during coughing or sneezing. However, depending on the type of face masks, the protection rate varies from 33 to 100% in the process of expiratory emissions [20]. For example, cloth face masks have moderate efficacy in the prevention of the disseminated respiratory infections resulting from particles of the same size or smaller than those of COVID-19 [21]. Therefore, many countries have enforced the use of face masks.

A high degree of community compliance with face masking will maximize the reduction in the rate of infections. There are several possible reasons that decrease the compliance of individuals with wearing face masks during the outbreaks. The most important of which are the lack of knowledge, misconception, appearance, and barriers preventing compliance. Assessment of the community's compliance in wearing face masks requires information about their knowledge, attitudes, and perceptions, and then, identification and assessment of the barriers preventing compliance. Physical and social discomfort, confusion or misinformation, low perceived susceptibility to COVID-19, and perceptions of identity and autonomy were reported as the main barriers in using face masks [18].

Compliance is highly affected by the individual's positive perception, which by itself is influenced by knowledge. Measuring the compliance with the mandate of using face masks by the community is of great importance. However, information on the acceptability of the different types of face masks in preventing COVID-19 is scanty and disputed [26]. A few studies have reported on the knowledge, attitude, and practice of health workers regarding

the use of face masks for the prevention of SARS-CoV-2 transmission [19, 20]. Studies on the practice and disposal methods are hardly found.

The aim of this study is to investigate the knowledge and compliance of the community in wearing face masks for COVID-19 prevention. The study also investigates the overall perceptions of barriers to wearing face masks. Therefore, possible recommendations for the improvement of community compliance with wearing face masks will be suggested based on the findings of this study.

MATERIAL AND METHODS

This study was approved by the CINEC ethical review committee. It was conducted online questionnaire, and every participant was given online written informed consent.

The questionnaire was sent for validation before the commencement of the study. This pretested questionnaire was prepared according to the objectives after the literature review. The questionnaire consists of 23 questions and 8 questions were directed to assess the usage pattern of facemasks. The questionnaire was administered to the participants by a web link through various social media applications.

STATISTICAL ANALYSIS

The participants' knowledge and attitude were measured by questions on a five-point Likert scale rating, ranging from strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The mean score of every question was calculated out of five. The average knowledge and barriers against using face masking scores were calculated out of 25 points for the five related questions. The attitude and misconception of the participants' scores were measured out of 40 points for the eight questions. For the questions related to compliance with wearing face masks, the same five-point Likert scale rating was used, ranging from always (5), frequently (4), occasionally (3), rarely (2), and never (1). The average score was calculated out of 15 for the three questions.

RESULTS

This study represented all districts in Sri Lanka Demographic details were analyzed at the phase 1. We found that 99% participants had used the FM. Out of this group, 55% were found to be females and 45% were males.

Figure 1

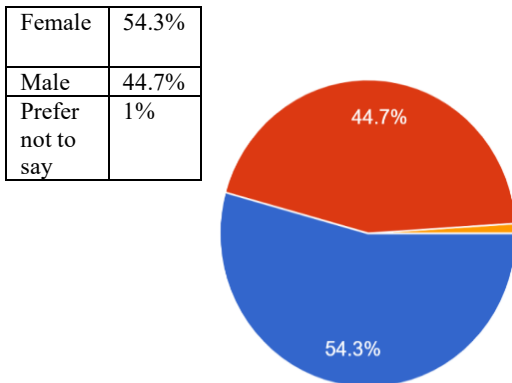


Figure 1 shows the male to female ration of our study group.

Our study participation was covered in all over the country and table 1 shows coverage in Sri Lanka

Table 1 - coverage in Sri Lanka

residence		Frequency	Percent
District	Ampara	3	1.1
	Anuradhapura	9	3.4
	Badulla	9	3.4
	Batticaloa	4	1.5
	Colombo	22	8.2
	Galle	22	8.2
	Gampaha	14	5.2
	Hambantota	21	7.9
	Jaffna	13	4.9
	Kalutara	11	4.1
	Kandy	23	8.6
	Kegalle	18	6.7
	Kilinochchi	6	2.2
	Kurunegala	21	7.9
	Mannar	3	1.1
	Matale	8	3.0
	Matara	9	3.4
	Moneragala	7	2.6
	Mullativu	3	1.1
	Nuwara Eliya	3	1.1
	Polonnaruwa	5	1.9
	Puttalam	2	.7
	Ratnapura	18	6.7
	Trincomalee	6	2.2
	Vavuniya	7	2.6
	Total	267	100.0

Age distribution

In relation to the age group, 71% of participants are young, 17% middle-aged and the rest (12%) of above 40 years. Further, 74% of participants used FM are tertiary educators and the rest are from school education.

Type of face mask

Our study showed that 50% of them were KN95/N95 users, 40% were disposable surgical masks, 6% used cloth masks and 4% of other types.

Reuse and Washing frequency of reuseage.

65% of study participants had reused all types of FM and 35% of them had not used it again. Figure 2 shows the frequency of washing of face mask after usage.

How frequently do you wash your reusable cloth mask?
385 responses

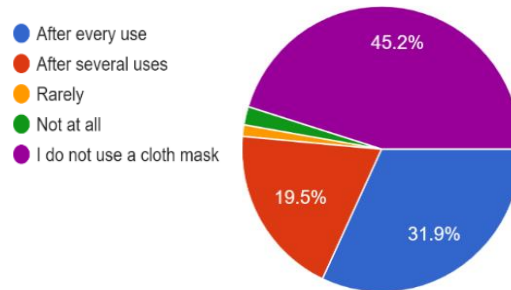


Figure 2 - frequency of washing of the face mask.

Figure 2 shows the frequency of washing of the face mask. The majority had washed after every single use and some participants had washed after several uses and some have never washed it. People who do not use cloth masks are also shown here.

Face mask using time.

Table 2 shows the usage time of the face mask of our study population.

Table 2 shows the majority had used FM within 1-3 hours and around 4.7% of the had used it more than 12 hours at once.

<30 minutes	4.9%
30-45 minutes	12.5%
1-3 hours	31.9%
3-6 hours	28.1%
6-12 hours	17.9%
>12 hours	4.7%

Touching the exposed side of face mask

Figure 3 shows 49.6% of participants mentioning that they unconsciously touch the exposed side while wearing or removing, 7.8% of them said yes to this question and 42.6% said they never touch the front side.

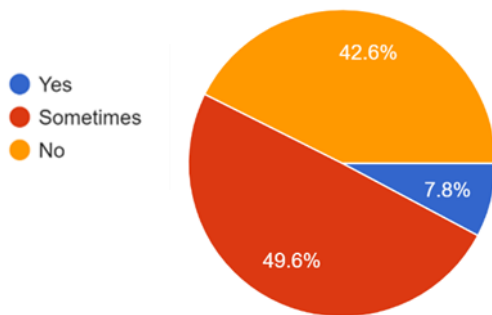


Figure 3 - *Touching the exposed side of face mask*

Removal of mask while talking

Table 3 shows how frequently they remove the mask while talking.

Table 3 - percentage of the participants removing mask while talking.

Yes	1.8%
Sometimes	23.6%
no	74.5%

Disposal practice

Table 4 shows the percentage of good practice of disposal of used face mask.

Table 4 - percentage of good practice of disposal of used face mask.

Yes	68.3%
Sometimes	26%
no	5.7%

Knowledge on potential risk of using nonsurgical mask.

56.9% of participants showed that they are aware of the risk and interestingly, 32.7% of them said they don't know.

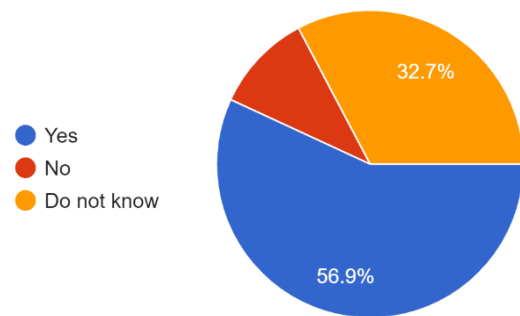


Figure 4 - *Knowledge on potential risk of using nonsurgical mask.*

We further researched the knowledge on the best type of mask, and we find the results as indicated in table 5.

Table 5 – percentage of participants' knowledge on best type of mask

Surgical mask	19.2%
KN95/N95	71.4%
Cloth mask	1%
Cone style	1.6%
Do not know	6.8%

DISCUSSION

This study was conducted to evaluate the knowledge and practices of wearing face masks during an epidemic in Sri Lanka. Our literature survey indicated that guidelines for wearing masks differ significantly between countries . Further, all the referred studies had the same opinion on the face mask using practice, and benefits of the face mask usage depended on society compliance. Results of our study on FM

usage practice was compatible with the study on a Malaysian community and both studies showed the more than 80% of participants had the knowledge of prevention. Both studies indicated KN95, or surgical type FM were the common facemasks used. Another Sri Lankan study published in the disaster prepared and response division in Sri Lankan government, had found out 47% had used the cloth masks and 61% of them had used surgical and KN95 type. This is compatible with our finding. Most of the participants who used the disposable face masks, had re-used it. This cannot be recommended and the purpose of using the face mask has been impeded. In addition to that some of our participants had used cloth masks and interestingly they believed that it was the best face mask. Filtration effectiveness is lower than the surgical and medically prepared masks [22]. Previous controlled clinical studies had shown that rate of infections is higher in cloth face masks compared to surgical masks [23,24]. A few more studies in relation to cloth face masks had stated that the many factors; thread count, number of layers, type of fabric, and water resistance had determined the effectiveness of the filtration [25]. Wearing at least a cloth mask would be healthier than not wearing face mask during the epidemic. We did not find any person without wearing mask during this critical time.

50% of the participants in this Sri Lankan study had bad practice of touching the outside of face mask when removing or wearing. Misconceptions of wearing face mask were very low despite the unhealthy practices. This must be reiterated to society to adhere to the proper and healthy way of wearing face masks. Most of the studies conducted in the past had stated that most of the participants had used single face mask for 4-8 hrs per day which is compatible with our finding.

Considering all our findings and previous researchers, it is a common sequelae of practicing unhealthy way of using facemask in some communities. This may be related to the socioeconomic status of the user and therefore as the governments of Sri Lanka.

CONCLUSION

The study has revealed a good compliance rate in wearing face masks in public and workplaces in Sri Lanka but the unhealthy practices of usage. It would be recommended to the Sri Lankan Ministry officials in relation to the health to enhance general public awareness campaigns about the appropriate use and practice of face masks. This may be important not only to cover the epidemic but for the intermittent ongoing viral endemics happening time to time in Sri Lanka

REFERENCES

1. Matuschek, C., Moll, F., Fangerau, H., Fischer, J. C., Zänker, K., van Griensven, M., ... & Haussmann, J. (2020). Face masks: benefits and risks during the COVID-19 crisis. *European journal of medical research*, 25, 1-8.
2. Edirisuriya CS *et al.*, 2020. *can face masks protect you from COVID-19*, s.l.: s.n.
3. Howard *et al.*, 2020. *Face masks against Covid -19 : An evidence review*, s.l.: Research Gate. <https://www.hpb.health.gov.lk>, n.d. s.l.: s.n.
4. Huai-Liang Wu *et al.*, 2020. *Face masks shortage and novel corona virus disease (covid-19) outbreak*, s.l.: eclinical medicine
5. Islam *et al.*, 2020. Perception and Attitudes Toward PPE-Related Waste Disposal Amid COVID19 in Bangladesh: An Exploratory Study. *BRIEF RESEARCH REPORT ARTICLE*, Issue 13 November 2020, p. 6.
6. Krejcie, R.V. and Morgan, D.W., 1970. Determining sample size for research activities. *Educational and psychological measurement*, 30(3), pp.607-610.
7. Maragakis, L. L., 2020. *Coronavirus Face Masks & Protection FAQs*, s.l.: Johns Hopkins Medicine Home.
8. Massimiliano Scalvenzi *et al.*, 2020. *Community Knowledge about the use*,

- reuse, disinfection and disposal of masks and filtering face piece respirators*, s.l.: Journal of Community Health.
9. Matuschek *et al.*, 2020. *Face masks benefits and risks during covid 19 crisis*, s.l.: european journal of medical research.
 10. Piotr Nowakowaski *et al.*, 2020. *Disposal of Personal protective equipment during the covid-19 is a challenge for waste collection companies and society*, s.i.: Resources.
 11. Priya B, *et al.*, 2020. An Assessment on the Awareness and Education among General Public : Concerning Rational use of Face Masks during the COVID - 19 Pandemic. *Ijppr. Human*, 18(3), pp. 629-641.
 12. Sangkham, S., 2020. Face mask and medical waste disposal during the novel COVID-19 pandemic. *Article in Case Studies in Chemical and Environmental Engineering*, Issue 19 October 2020., p. 10.
 13. Shuo Feng, 2020. rational use of face masks in the COVID-19 pandemic. *THE LANCET*, 8(5), pp. 434-436.
 14. Srilankabusiness.com. 2021. Face Masks and Respirators Made in Sri Lanka - EDB Sri Lanka. [online] Available at: <<https://www.srilankabusiness.com/ppe/face-masks/>> [Accessed 9 February 2021].
 15. Van der Sande *et al.*, 2008. Professional and homemade face masks reduce exposure to respiratory infections among the general population.
 16. World Health Organization. (2021). WHO Coronavirus Disease (COVID-19) Dashboard. <https://covid19.who.int/>
 17. Trisha G, Schmid MB, Czypionka T, Bassler D, Gruer L. Face masks for the public during the covid-19 crisis. *BMJ* 2020;369: m1435. pmid:32273267
 18. Eikenberry SE, Mancuso M, Iboi E, Phan T, Eikenberry K, Kuang Y, et al. To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic. *Infect Dis Model.* 2020;5: 293–308. pmid:32355904
 19. Irfan Ul Haq M, Khuroo S, Raina Khajuria S, Javaid M, Ul Haq MF, et al. 3D printing for development of medical equipment amidst coronavirus (COVID-19) pandemic—review and advancements. *Res. Biomed. Eng.* (2020). <https://doi.org/10.1007/s42600-020-00098-0>
 20. Lai A., Poon C., & Cheung A. (2011). Effectiveness of facemasks to reduce exposure hazards for airborne infections among general populations. *J R Soc Interface.* 2012; 9: 938–948. pmid:21937487
 21. Lima MMdeS, Cavalcante FML, Macedo TS, Galindo N, Nelson M, Caetano JA, et al. Cloth face masks to prevent Covid-19 and other respiratory infections. *Rev. Latino-Am. Enfermagem* 2020;28: e3353. pmid:32785565
 22. Chughtai AA, Seale H, Macintyre CR. Effectiveness of Cloth Masks for Protection Against Severe Acute Respiratory Syndrome Coronavirus 2. *Emerg Infect Dis.* 2020 Oct;26(10):e200948. doi: 10.3201/eid2610.200948. Epub 2020 Jul 8. PMID: 32639930; PMCID: PMC7510705.
 23. MacIntyre CR, Seale H, Dung TC, Hien NT, Nga PT, Chughtai AA, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. *BMJ Open.* 2015;5:e006577. 10.1136/bmjopen-2014-006577
 24. Davies A, Thompson KA, Giri K, Kafatos G, Walker J, Bennett A. Testing the efficacy of homemade masks: would they protect in

an influenza pandemic? *Disaster Med Public Health Prep.* 2013;7:413–8. 10.1017/dmp.2013.43

25. Chughtai AA, Seale H, MacIntyre CR. Use of cloth masks in the practice of infection control—evidence and policy gaps. *Int J Infect Control.* 2013;9:1–12. 10.3396/IJIC.v9i3.020.13
26. Shelus VS, Frank SC, Lazard AJ, Higgins ICA, Pulido M, Richter APC, et al. Motivations and Barriers for the Use of Face Coverings during the COVID-19 Pandemic: Messaging Insights from Focus Groups. *Int J Environ Res Public Health.* 2020;17: 9298. pmid:33322672

Original Article

Antioxidant Capacity Variation Across Different Parts of *Allamanda cathartica* (Golden Trumpet) Plant

Dissanayake D. M.W.L¹, Bandara J. M. V.R.J², Tennakoon T. M.S.A¹, Kavindhya I.S¹, Sandeepa K.D¹, Ratnayake W.M.K.M²

¹Department of Pharmacy and Pharmaceutical Sciences, Faculty of Health Sciences, CINEC Campus, Sri Lanka

²Department of Cosmetic Science, Faculty of Health Sciences, CINEC Campus, Sri Lanka

kalpani.ratnayake@cinec.edu

ABSTRACT

Allamanda cathartica is a herbal plant in the Apocynaceae family, often known as "Wel Rukaththana" in Sinhala, "Thimble Lady," or "Golden Trumpet" in English. Traditional medicine has utilized this plant's leaves, roots, stems, blossoms, and entire plant to cure a variety of illnesses since ancient times. Even though *A. cathartica* is a commonly used herb, the literature review indicated that there is a scarcity of published scientific evidence about its therapeutic usefulness. Hence, the present study aimed to evaluate the comparison of antioxidant activity of fresh leaves, roots, stems and flowers of this plant by using 1, 1-diphenyl-2-picrylhydrazyl (DPPH) assay. Fresh plant materials were collected from the Colombo district and authenticated. Hot aqueous extracts of fresh leaves (AEFL), roots (AEFR), stems (AEFS) and flowers (AEFF) were prepared with 3 g/mL concentrations. *In-vitro* antioxidant activity of the concentration gradients of each extract was evaluated by using a DPPH assay. Ascorbic acid (6.25 µg/mL- 25 µg/mL) was used as a positive control. The radical scavenging activity of test samples was expressed as an EC₅₀. The hot aqueous extract showed antioxidant activity with an EC₅₀ value of 10.92 µg/mL, 22.10µg/mL, 23.76 µg/mL and 27.38 µg/mL for leaves, flowers, roots and stems respectively while the ascorbic acid showed an EC₅₀ value of 13.40 µg/mL. In conclusion, the results showed that AEFL has a significant ($p < 0.05$) antioxidant potential than AEFR, AEFS and AEFF. Hence, fresh leaves of *A. cathartica* have been identified as the most potential part for antioxidant activity among tested plant parts.

Index Terms- *Allamanda Cathartica*, Antioxidant, DPPH

INTRODUCTION

Excessive levels of free radicals can accumulate within the human body cells, and this can lead to certain degenerative diseases such as atherosclerosis, ischemic heart diseases and cancers [1]. These free radicals can alter the structure and function of biomolecules within cells. These alterations have the potential to cause cancer or even mutagenesis in healthy cells [2]. Hence, the human body needs antioxidants to protect the body from overabundance of free radicals.

There are different antioxidants with natural and synthetic origins. While butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are some examples of synthetic antioxidants, organic acids, phenols, flavonoids, tannins and curcuminoids are some examples of naturally occurring antioxidants in plant sources [3]. The natural antioxidants can be dispersed throughout the plants including leaves, stems, roots, bark, flowers, fruits and seeds. As some synthetic antioxidants such as BHA and BHT have reported certain adverse effects such as liver damage and carcinogenic potential [4], considering the comparatively less toxic natural antioxidants have a huge demand. Hence, recent research has paid attention to identifying the antioxidant potential of herbal plants and the isolation of antioxidant compounds from them.

Allamanda cathartica (named "Wel Rukaththana" in Sinhala; "Golden Trumpet" in English) is a herbal plant that belongs to the family Apocynaceae. This is commonly found as an ornamental shrub in the garden (Plate 1) in tropical and subtropical regions [5]. This is a perennial plant and mainly grows in Sri Lanka as an ornamental plant in home gardens and roadside in all wet, dry

and intermediate zones. The leaves, roots, stems, flowers and the entire plant have been used for centuries in traditional medicine to treat various diseases [6, 7]. Hence, *Allamanda cathartica* plays an important role in Ayurveda and Unani medicine. An infusion of the bark and leaves of this plant is used as a purgative, in traditional medicine [6]. Also, on the bites of insects, the paste of root is administered. Further, the plant is used to treat liver tumours, jaundice, splenomegaly, malaria, and severe stomach discomfort. The plant's compounds aid in reducing inflammation and enhancing blood circulation [7].

In addition to the traditional uses, the scientific literature also showed that different parts of this plant contain numerous pharmacological activities such as anti-inflammatory, antioxidant, antidermatophytic, antimicrobial, wound healing, hepatoprotective and antifertility activities [6].



Plate 1: Morphology of *A. cathartica* plant

According to Shivananda *et al.* [8], the aqueous extract of *A. cathartica* showed wound healing activity on excision and incision wound models in Sprague Dawley rats [8]. As shown by Nahar *et al.* [9] dichloromethane extract of the whole plant of *A. cathartica* showed an antidermatophytic effect on two pathogenic dermatophytes *Microsporum gypseum* and *Trichophyton rubrum*. However, they have shown the absence of this activity in the methanolic extract of whole plants [9].

Further, aqueous leaf extract of *A. cathartica* showed reversible suppression of fertility in male Parkes strain mice, when orally administered in the dose of 150 mg/kg of body weight [10]. Pothan and Harindran [11] evaluated the hepatoprotective activity of aqueous and methanol extracts of *A. cathartica* flowers and roots, using the MTT assay. The results showed

that 1000 $\mu\text{g/mL}$ of root extract contains 86% protection while flowers contain 81% protection for the same concentration [11].

In 2018, Safitri and his coworkers screened the antioxidant effect of different extracts i.e. aqueous, ethanol and n-hexane, of *A. cathartica* leaves obtained from South Sulawesi [12]. They identified, the aqueous extract of *A. cathartica* ($\text{IC}_{50} = 44.9 \mu\text{g/mL}$) as the strongest antioxidant extract compared to the ethanol and n-hexane extract which showed 106.4 $\mu\text{g/mL}$ and 164 $\mu\text{g/mL}$ respectively as their IC_{50} value. The quercetin which is the reference standard showed 9 $\mu\text{g/mL}$ as its IC_{50} value in DPPH assay [12].

The phytochemical screening of methanol and aqueous extracts of flowers and roots of *A. cathartica* have shown that all extracts contain alkaloids, flavonoids, glycosides, amino acids and starch [11]. Further, there was the absence of anthraquinones, gums and mucilage. However, the methanol extract of roots shows the absence of saponins, although all other tested extracts contained it [11]. However, external environmental variables such as light, temperature, soil water, soil fertility and salinity can have a substantial impact on various plant processes including the synthesis of secondary metabolites, which can ultimately alter the overall phytochemical composition of the plant. Hence, although it is the same plant species, we can see variations in their phytochemistry and medicinal properties depending on geographical variations.

Although different parts of this plant are used in the traditional medicinal system in Sri Lanka, there is a paucity of literature about the biological activities of this plant. Hence, the present study was focused on investigating the antioxidant potential of different parts of *A. cathartica* i.e. leaves, roots, stems and flowers, grown in Sri Lanka. This finding will provide scientific evidence to use aqueous extract of this plant in the development of pharmaceutical and cosmeceutical antioxidant products in future.

MATERIALS AND METHODS

Plant materials

Fresh samples of leaves, flowers, roots and stem of *A. cathartica* were collected from the Colombo district, Sri Lanka. The plant materials of *A. cathartica* were authenticated by the National Herbarium, Department of National Botanical Garden, Peradeniya, Sri Lanka.

Chemicals

The special chemicals of 2,2-diphenyl-1-picrylhydrazyl (DPPH) and Ascorbic acid purchased from Sigma-Aldrich Company, were used for the assays. All other chemicals were analytical grade.

Preparation of the plant extracts

The collected mature fresh parts of *A. cathartica* i.e., leaves, flowers, roots and stems were washed from tap water and then distilled water. After that, all plant materials are cut into small pieces. To prepare the aqueous extract of fresh leaves of *A. cathartica* (AEL), 50 g of small pieces of fresh leaves were refluxed with 150 mL of distilled water for 30 minutes. The extract was filtered using suction filtration, and the filtrate was collected. Same method was followed to prepare an aqueous extract of fresh flowers, roots and stems of *A. cathartica* and they were named AEF, AER and AES respectively.

Evaluation of *in-vitro* antioxidant activity by DPPH assay

According to Ratnayake *et al.* [13], the scavenging activity of the stable 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical was used to evaluate the *in-vitro* antioxidant activity [13]. To prepare the 0.25 mM DPPH solution, 10 mg of DPPH was dissolved into 250 mL of absolute methyl alcohol, which was homogenized and transferred to an amber flask, duly labelled. Concentration gradients for each part of *A. cathartica* were prepared by using a stock solution containing a concentration of 1 g/3 mL solution. The Ascorbic acid stock solution 10 mg/mL was prepared by dissolving 0.5 g of Ascorbic acid in 50 mL of distilled water. A series

of test solutions of Ascorbic acid with varying concentrations (0.625 µg/mL – 25 µg/mL) were prepared.

The reaction mixtures were prepared by mixing an aliquot of DPPH solution and methanol (in negative control) or test samples (AEL or AEF AER or AES) or Ascorbic acid (in positive control) as shown in Table 1.

After that, the reaction mixtures were allowed to reach a steady state in the dark at room temperature. The absorbances were measured at 517 nm after 30 minutes.

Table 1: Content of reaction mixtures in *in-vitro* antioxidant evaluation by DPPH assay

	NC (mL)	PC (mL)	TS (mL)	CBT (mL)
DPPH solution	1.5	1.5	1.5	NA
Methanol	1.5	NA	NA	1.5
AEL/AEF/AER/AES Solutions	NA	NA	1.5	1.5
Ascorbic acid solution	NA	1.5	NA	NA

NC: Negative control; TS: Test sample (AEL/AEF/AER/AES); CBT: Colour blank for test sample, PC: Positive control (Standard solution).

All the tests were performed in triplicate for each concentration. Antioxidant activity was measured in terms of radical scavenging activity and the percentage scavenging effect was calculated using the following formula.

$$\text{Scavenging activity (\%)} = \frac{[A_0 - A_T]}{A_0} \times 100$$

Where A_0 is the absorbance of the negative control and A_T is the absorbance of the test sample (AEL/AEF/AER/AES or Ascorbic acid). The radical scavenging activity of test samples was expressed as a mean of EC_{50} (µg/mL), which is defined as the mean concentration of the antioxidant required to lower the initial DPPH concentration by 50% in each experiment. It was determined by using the graph plotted with the mean concentration of triplicates of each test.

STATISTICAL ANALYSIS

All the results were subjected to descriptive statistics and expressed as mean ± standard

RESULTS

DPPH percentage inhibition of the scavenging activity of AEL, AEF, AER and AES are shown in Figure 1, Figure 2, Figure 3 and Figure 4 respectively. Also extracts showed significant (p<0.05) dose dependent DPPH scavenging activity.

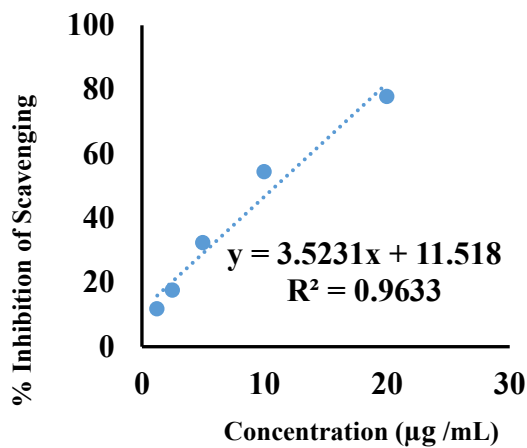


Figure 1–Percentage inhibition of DPPH radical scavenging activity for aqueous extract of *A. cathartica* leave

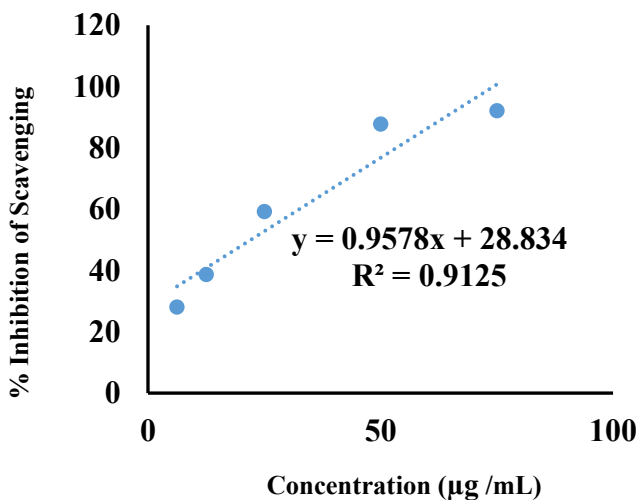


Figure 2–Percentage inhibition of DPPH radical scavenging activity for aqueous extract of *A. cathartica* flowers

deviation (SD). Data were analyzed by using SPSS statistic software. p-values < 0.05 were considered as statistically significant.

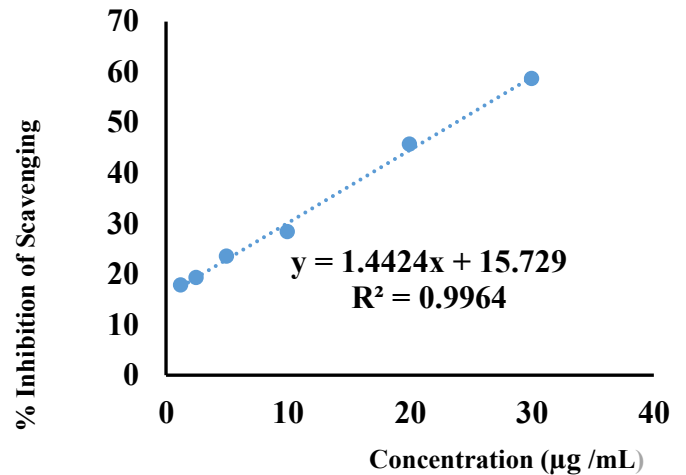


Figure 3–Percentage inhibition of DPPH radical scavenging activity for aqueous extract of *A. cathartica* roots

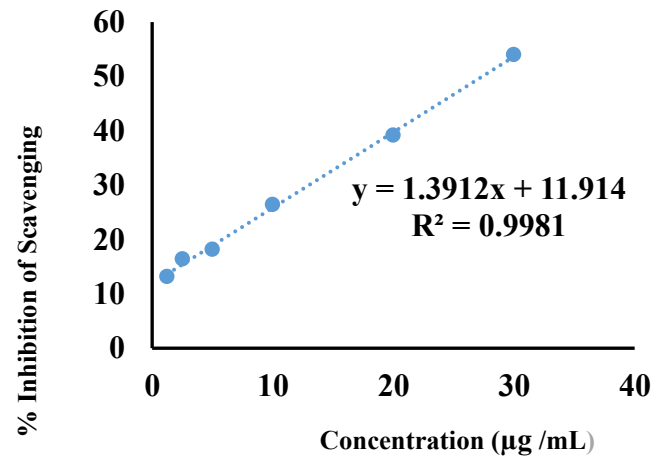


Figure 4–Percentage inhibition of DPPH radical scavenging activity for aqueous extract of *A. cathartica* stem

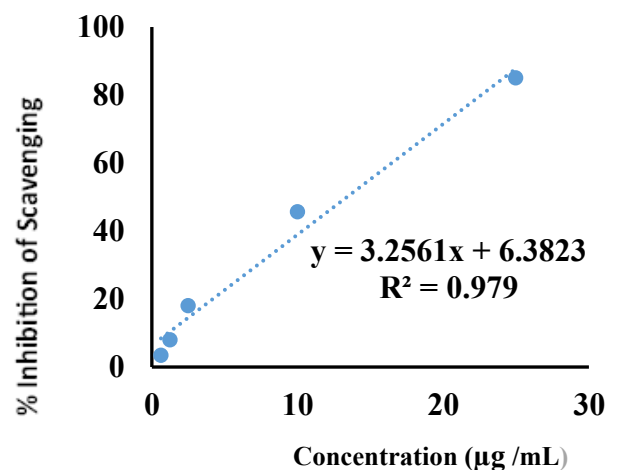


Figure 5 – Standard Curve for Ascorbic Acid in DPPH assay

The results (Table 2) showed that leave extract has more significant antioxidant activity compared to the other three extracts which are prepared from flowers, stems and roots. This activity is higher than standard ascorbic acid, which has an EC₅₀ value of 13.40 µg/mL.

Table 2: EC₅₀ µg/mL values in DPPH assay

Sample	EC ₅₀ value
Aqueous extract of <i>A. cathartica</i> leaves (AEL)	10.92 µg/mL
Aqueous extract of <i>A. cathartica</i> flowers (AEF)	22.10 µg/mL
Aqueous extract of <i>A. cathartica</i> roots (AER)	23.76 µg/mL
Aqueous extract of <i>A. cathartica</i> stems (AES)	27.38 µg/mL
Ascorbic acid (Positive control)	13.40 µg/mL

DISCUSSION

Because of their safeness, tolerability and non-toxicity, natural antioxidants are considered comparatively superior to synthetic ones [12]. Hence, the free radical scavenging antioxidants of plant origin are abundantly used in the form of vitamins, minerals and nutraceuticals. [13].

Hameeda and coworkers [15] conducted a comparison of the antioxidant activities of roots, shoots, leaves and flowers of *A. cathartica*. According to them, the roots of *A. cathartica*, showed the highest enzymatic antioxidants such as superoxide dismutase (SOD), peroxidase (POD), and catalase (CAT). Also, it showed the highest total phenolic contents compared to the other test parts of the plant [14]. according to Coelho *et al.* [17], the ethanol extract of dried leaves of *A. cathartica* showed a greater amount of phenolic compounds compared to its flower extract. According to the analyzed standards, they have identified the presence of several phenolic compounds, such as chlorogenic acid, caffeic acid, p-coumaric acid and ferulic acid in leaves [15]

Khatoon and his coworkers [1] worked on methanol extracts of leaves and stems of *A.*

cathartica prepared by maceration technique. They assessed total phenolics content as mg of gallic acid equivalents (GAE) and the total flavonoid content as mg of quercetin equivalents (QE) The study showed the leaf extract contains total phenolic in 53.35 ± 1.87 mg/GAE/g and total flavonoids in 170.30 ± 0.10 mg QE/g whereas, it was 38.78 ± 0.00 mg/GAE/g and 140.30 ± 0.10 mg QE/g for stem extract respectively [1]. As total flavonoids and phenols are two of the compounds mainly involved in the antioxidant potential of plants, this evidence provides scientific support for the results we received in this study, where it showed leave extract contains more antioxidant activity than the stem in the DPPH assay.

In 2018, Safitri and his co-workers [11] showed that an aqueous extract of *A. cathartica* leaves obtained from South Sulawesi has antioxidant potential with IC₅₀= 44.9 µg/mL. However, our study showed that the EC₅₀ value was 10.92 µg/mL for the *A. cathartica* leaves collected from Colombo, Sri Lanka. In addition, Safitri, Handayani and Waris used dried leaves while we used fresh leaves. Hence all of these factors may contribute to the different EC₅₀ values shed on the aqueous extract of *A. cathartica* leaves.

CONCLUSION

The fresh hot aqueous extract showed antioxidant activity with an EC₅₀ value of 10.92 µg/mL, 22.10µg/mL, 23.76 µg/mL and 27.38 µg/mL for leaves, flowers, roots and stems respectively. The ascorbic acid showed an EC₅₀ value of 13.40 µg/mL. In conclusion, the present findings provided scientific evidence for the *in-vitro* antioxidant properties of the different fresh parts of *A. cathartica*. Hence, the leaves of *A. cathartica* displayed comparatively higher antioxidant potential than in other parts. The plant, particularly its leaves, can be used to make pharmaceutical herbal medicines and may be useful in the identification, purification, and isolation of novel phytoconstituents with therapeutic applications.

ACKNOWLEDGEMENT

Authors would like to express gratitude to the Faculty of Health Sciences, CINEC Campus Sri Lanka.

CONFLICT OF INTERESTS

The authors declare there is no conflict of interest.

REFERENCES

1. Khatoon, M., Islam, E., Islam, R., Rahman, A. A., Khurshid Alam, A. H. M., Khondkar, P., Rashid, M. and Parvin, S. 2013. Estimation of total phenol and *in-vitro* antioxidant activity of *Albizia procera* leaves, BMC Research, 6: 121.
2. Harliansyah, 2001 'Mengunyah Halia Menyakit', Indonesian Student Association in Malaysia, Artikel.
3. Blainski, A., Lopes, G. C. and de Mello, J. C. P. 2013. Application and analysis of the Folin Ciocalteu method for the determination of the total phenolic content from *Limonium brasiliense* L, Molecules, 18: 6852-6865.
4. Zhu, K., Lian, C, Guo, X, Peng, W., Zhou, H. 2011. Antioxidant activities and total phenolic contents of various extracts from defatted wheat germ, Food Chemistry, 126: 1122-1126.
5. Loss, A., Teixeira, M. B., Assuncao, G. M., Haim, P. G., Loureiro, D. C., Souza, J. R., 2008. Revista de Ciencias Agrarias, 3: 313-6.
6. Chaithra, A. B., Satish S., Karunakara H. 2016. Therapeutic Uses of *Allamanda Cathartica* Linn. With A Note on Its Pharmacological Actions: a Review, International Journal of Pharma And Chemical Research, 2(4): 227-232.
7. Suprpta, D. N., Khalimi, K. 2012. Anti-fungal activities of selected tropical plants from Bali Island, Phytopharmacology, 2(2): 265-270.
8. Shivananda, N., Poorna, N., Steve, S., Vidyasagar, B., Andrew A. 2006. Evaluation of wound healing activity of *Allamanda cathartica*. L. and *Laurusnobilis*. L. extracts on rats. BMC Complementary and Alternative Medicine, 6 (12): 1-6.
9. Nahar, A., Ashrafuzzaman, S., Islam, M. N., Alam, M. S. 2010. Studies on anti-dermatophytic effect of *Allamanda cathartica*, A Journal of the Bangladesh Pharmacological Society, 5: 5-7.
10. Singh, A., Singh, S. K. 2008. Reversible antifertility effect of aqueous leaf extract of *Allamanda cathartica* L. in male laboratory mice, Andrologia: 40(6): 337-45.
11. Pothan, N., Harindran, J. 2014. *In-vitro* hepatoprotective activity of *Allamanda cathartica linn* on the BRL3A cell lines, International Journal of Institutional Pharmacy and Life Sciences, 4(3): 1-11.
12. Safitri, I. Handayani, V., Waris, R. 2018. Identification and antioxidant activity of Alamanda leaf (*Allamanda chatartica* L) based on solvent variation, International Journal of Advances in Science Engineering and Technology: 5-10.
13. Ratnayake, W. M. K. M., Suresh T. S., Abeysekera, A. M., Salim, N., Chandrika U. G. 2019. Acute anti-inflammatory and anti-nociceptive activities of crude extracts, alkaloid fraction and evolitrine from *Acronychia pedunculata* leaves. Journal of ethnopharmacology. 238:111827.
14. Kumar S. 2011. Free radicals and antioxidants: human and food system. Advanced in Applied Science Research, 2 (1):129-135.
15. Patil, S., Kadam, V., Ghosh, R. 2009. *In-vitro* antioxidant activity of methanolic extract of stem bark of *Gmelina arborea*

Roxb. (Verbenaceae). International Journal of Pharm Tech Research. 1(4):1480–1484.

16. Hameeda, A., Nawazb, G., Gulzarb, T. 2014. Chemical composition, antioxidant activities and protein profiling of different parts of *Allamanda cathartica*, Natural Product Research: 2066-2071.
17. Coelho, H. A., Silveira, L. H. C., Araujo, J. H. B., Kwiatkowski, A. 2016. Antioxidant and antimicrobial potential of phenolic compounds extracted from leaves and flowers of *Allamanda cathartica* L., Revista Brasileira de Plantas Medicina, 18(3): 650-656.

A Study on Impact of Green Supply Chain Management Practices on the Environmental Performance of Apparel Industry in Sri Lanka

Herath P¹, Gunawardana A²

¹Department of Logistics and Transportation, Faculty of Management and Social Sciences, CINEC Campus, Malabe, Sri Lanka

²Department of Management and Business Studies, Faculty of Management and Social Sciences, CINEC Campus, Malabe, Sri Lanka

pavithrasewwandi.tfc@gmail.com

ABSTRACT

Setting new strategies has become necessary due to increased attention to environmental concerns and a rising tendency among nations and organizations toward environmental sustainability. This study explores the impact of Green Supply Chain Management Practices on environmental performance in the Sri Lankan apparel industry. As a result, the study's objectives are to identify the impact of green supply chain management practices on environmental performance and provide recommendations for improving the environmental performance of the apparel industry. This study mainly focused on investigating the level of green supply chain management practices (GSCMP) including Internal Environment Management (IE), Eco Design (ED), Green Manufacturing (GM), Green Purchasing (GP), and Cooperation with Customers (CC). By adopting the convenience sampling technique and quantitative survey method and using a self-administered questionnaire, the study collects data from 60 employees, including managers and executives, from three leading apparel manufacturing companies located in the Western and North Western provinces of Sri Lanka. These findings imply that GSCMP are more likely to impact environmental performance, as evidenced by correlations and regression analyses. The study will analyze the data to identify the extent to which green supply chain management practices are implemented in the industry and provide insights into the potential benefits of green supply chain management practices for the apparel industry in Sri Lanka. Furthermore, the study's limitations are discussed, and potential areas for further research based on the study's findings are highlighted.

An exploratory study can also examine the influence of GSCMP practices on organizational performance based on the other service sectors of Sri Lanka.

Index Terms- Supply Chain Management, Green Supply Chain Management Practices, Environmental Performance, Sustainability, Apparel Industry

INTRODUCTION

Today's economic environment is more competitive and global than in the past. We can see the shorter product life cycles, rapid new product releases, and sophisticated clients who are becoming more intelligent and well-informed are characteristics of modern business. In this context, there has been an increase in the importance of corporate activity that is environmentally friendly, and many forward-thinking businesses are adopting green supply chain management. With the increase in globalization in every corner of the world, most businesses now realize the value of implementing Green Supply Chain Management (GSCM) techniques, particularly in connection to supply chain management, which also has positive environmental outcomes.

"Green supply chain management means adding "green" component to the company supply chain" (Meera & Dr. P. Chitramani, 2014). Over time, the concept of Green Supply Chain Management (GSCM) gained popularity among researchers and practitioners in the logistics chain for various reasons. According to the (Srivastava, 2001) defined GSCM, "stating that it involves incorporating environmental considerations into supply chain management (SCM), encompassing areas such as product and service design, procurement, manufacturing processes,

distribution, and end-of-life management, all aimed at achieving sustainable competitive advantage.” In today's complex and dynamic business environment, organizations must prioritize the adoption of Green Supply Chain Management Practices to remain competitive and survive.

Within the Sri Lankan business context, there is limited evidence regarding the adoption of green supply chain management practices and the impact of these practices on organizational performance. The challenge lies in striking a balance between achieving both environmental and economic sustainability, which has hindered the widespread adoption of green practices in design and manufacturing while maintaining a cost-effective supply chain.

This study aims to explore how the implementation of green supply chain practices can establish a sustainable environment within the apparel industry. Specifically, the research will focus on assessing the industry's environmental performance about sustainability. To achieve this, the study sets research objectives to examine the current state of green supply chain processes and practices and investigate the influence of implementing Green Supply Chain Management Practices on the apparel industry's organizational performance, particularly in terms of environmental performance in Sri Lanka.

The green logistics concept refers to all initiatives that are made to measure and minimize the environmental effects of logistics operations. This idea first appeared in the mid-1980s and was used to describe logistical techniques and systems that make use of state-of-the-art machinery and technology to minimize environmental harm (Marcus, et al., 2011). A variety of green business strategies that operate at various points in the supply chain process are included in sustainable business operations in manufacturing companies.

The Sri Lankan clothing industry has fully embraced the concept of environmentally friendly production, which extends beyond being a passing trend. Sri Lanka is at the forefront of innovative technologies in the apparel sector, exemplified by the world's inaugural "Green Garment Factory." This groundbreaking facility achieved a

remarkable 70% reduction in both energy and water consumption. By implementing efficient manufacturing practices, these businesses have achieved long-term viability, resulting in reduced expenses and accelerated returns on investment. To meet global standards for recycling, wastewater treatment, and waste management, companies in Sri Lanka strive for LEED Platinum and Gold certifications. Collaboratively, suppliers and manufacturers in Sri Lanka are actively working together to minimize the carbon footprint of the country's clothing industry, aiming to enhance sustainability and environmental consciousness. It is important to note that Sri Lanka adheres to the regulations established by the World Trade Organization (WTO) (Anon., 2022). According to the provisional data released by the (Sri Lanka Export Development Board (EDB), 2022) In September 2022, apparel and textile exports increased by 5% year over year to reach US\$ 479.88 Mn.

Table 1
Summary of the Supporting Literature

GSCMP	Operational Definition	Source
Internal Environment Management	Practice of developing GSCM as a strategic organizational imperative through commitment and support of the imperative from senior and mid-level managers	(Zhu, et al., 2008), (Rao & Holt, 2005)
Eco Design	Use of ecologic raw materials and recycling product at end of life, life cycle analysis of product	(Diab, et al., 2015), (Kumar & Chandrakar, 2012)
Green manufacturing	Equipping an environmental management system, Use of production techniques respectful of the environment	(Ninlawan, et al., 2010), (Amemba, et al., 2013), (Al-Odeh & Smallwood, 2012)
Green Purchasing	Selection of eco-suppliers, Environmental collaboration with suppliers	(Xiao, 2006), (SM, et al., 2015), (Zhu, et al., 2008)
Cooperation with Customers	Environmentally sustainable products with green packaging is a requirement for customer cooperation	(Theyel, 2001)

PROBLEM STATEMENT

As aforementioned, the purpose of this study was to examine the impact of Green Supply Chain Management (GSCM) practices on environmental performance.

Environmental concerns and global warming are gaining media attention in the garment sector, prompting organizations to consider greening their manufacturing farms for sustainability. While there may not be immediate financial gains, reasons include customer demand for environmentally friendly products, government tax deductions, environmentally friendly infrastructure, competitive advantages, and ethical position. Green supply chain management methods include internal environmental management, eco-design, and green purchasing. This research focuses on the impact of green supply chain practices on the Sri Lankan apparel industry, analyzing the adoption level and providing recommendations for improving environmental performance.

RESEARCH OBJECTIVES

The primary objective of this research is,

- To identify the impact of green supply chain practices on environmental performance of apparel industry of Sri Lanka.

According to the main objective the outcomes of the research would supplement the secondary objectives as stated below,

- To identify the most significant green supply chain practice that impacts environmental performance in Sri Lankan apparel industry.
- To give recommendations for improving environment performance in Sri Lankan apparel industry.

RESEARCH METHODOLOGY

A. Research Design

The research design section outlines the data collection and analysis methods, as well as the measurements for the variables identified in the problem statement. It provides a comprehensive overview of the research methodology, which aims to investigate the impact of green supply chain management (GSCM) practices on the

environmental performance of the apparel industry in Sri Lanka. Specific questions were formulated to measure each independent and dependent variable, drawing upon constructs, dimensions, and indicators derived from existing research literature.

A survey technique was employed, utilizing a hand-delivered questionnaire to reach every unit of analysis within the sample. This study adopted a quantitative approach, which enables the collection of categorical data required for statistical testing through the survey questionnaire. As the focus of this study is on examining the impact of green supply chain practices on environmental performance in the Sri Lankan apparel industry, data was gathered from various primary sources and will be analyzed accordingly. The research design of this study is descriptive and supported by relevant research articles as highlighted in the literature review.

B. Data Collection

The primary data collection method used for this study involved distributing a self-rated questionnaire through Google Forms. The questionnaire was distributed among 60 participants who are working in the sustainability department of the selected Apparel Manufacturing Companies located in Western and North Western provinces. Respondents were approached through email, phone calls, and in-person visits to the companies.

C. Data Analysis

In this study, five key demographic variables were analyzed which are gender distribution, age distribution, level of education, current job position and work experience in the apparel industry. Cronbach's alpha is utilized to assess the scale reliability of the study based on environmental performance. A Cronbach's alpha value of 0.7 or above is generally considered acceptable for scale reliability. The Cronbach's alpha values for all five dimensions of GSCM practices are above 0.7, indicating good internal consistency. The Cronbach's alpha value for the overall conceptual framework of the 25 items is 0.967, indicating a high level of internal consistency.

Based on descriptive statistics, the mean values for all variables are relatively high, ranging from 5 to 3.67, indicating agreement among the responses. The

highest standard deviation is observed in Eco Design (0.56), indicating higher variance, while the minimum standard deviation is in Green Manufacturing (0.41), indicating lower variance. The coefficients of skewness fall between -1 and +1, suggesting a normal distribution of the data. The absolute values of kurtosis are less than three times the standard error of kurtosis, further indicating a normal distribution and enabling the application of parametric techniques in the analysis.

According to the correlation analysis, all the probabilities are highly significant between the Environmental Performance (Dependent variable) and independent variables. Coefficients of correlation between them are positive. Their values are more than 0.7. This means that Internal Environment Management, Eco Design, Green Manufacturing, Green Purchasing and Cooperation with Customers are having strong positive correlation with Environmental Performance.

In the model summary, the multiple correlation (R Square value) is 0.980, indicating that approximately 98% of the variability in Environment Performance is accounted for by this model. All GSCM Practices show significant probabilities with positive beta values, indicating their influence on Environmental Performance. The probabilities for Internal Environment Management, Eco Design, Green Purchasing, and Cooperation with Customers are highly significant, with probabilities less than 0.01. This implies that these practices have a significant positive impact on Environmental Performance. Additionally, Green Manufacturing is also significant and positively influences Environmental Performance.

RESULTS AND DISCUSSION

This research study examines the impact of selected green supply chain management (GSCM) practices on environmental performance in the apparel industry of Sri Lanka. The study collected data through a questionnaire administered to apparel manufacturing companies with approximately 60 employees working in the sustainability department. The reliability of the

questionnaire was assessed using Cronbach's Alpha, which yielded a value of 0.967. Hypotheses were tested using correlation and regression analysis.

Table 2

Summary of findings of the study

No	Hypothesis	Regression		Acceptance
		B	Sig	Rejection
H ₁	There is a relationship between Internal Environment Management and Environment Performance	0.204	0.002	Accepted
H ₂	There is a relationship between Eco Design and Environment Performance	0.124	0.000	Accepted
H ₃	There is a relationship between Green Manufacturing Environment Performance.	0.240	0.022	Accepted
H ₄	There is a relationship between Green Purchasing the Environment Performance.	0.298	0.000	Accepted
H ₅	There is a relationship between Cooperation with Customers and Environment Performance.	0.266	0.000	Accepted

The regression analysis results indicate that GSCM practices significantly contribute to environmental performance ($F = 516.081, p = 0.000$). The R-square value is 0.980, indicating that the GSCM practices account for 98% of the variability in Environmental Performance explained by the model. Based on the regression analysis, it can be concluded that Green Purchasing has the highest impact on environmental performance ($p = 0.000$), making it the most significant practice among the GSCM practices.

CONCLUSION

The apparel industry has a significant impact on global environmental issues, such as pollution and waste generation. In Sri Lanka, the apparel industry is crucial to the economy but also poses environmental challenges. Implementing green supply chain practices can help improve the environmental performance of the apparel industry in Sri Lanka by promoting sustainability and reducing the overall environmental footprint.

Green supply chain practices involve adopting sustainable practices throughout the supply chain, from sourcing raw materials to production, transportation, and distribution. This requires collaboration and engagement from all stakeholders involved, including suppliers, manufacturers, retailers, and customers.

However, implementing green supply chain practices in the apparel industry in Sri Lanka comes with challenges and requires significant investment, collaboration, and commitment from stakeholders. It may also necessitate changes to existing practices and processes. Nevertheless, the benefits of adopting green supply chain practices outweigh the costs and can lead to a more sustainable and environmentally conscious apparel industry in Sri Lanka.

The adoption of green supply chain practices in the apparel industry in Sri Lanka offers several benefits. It can help reduce the industry's carbon footprint, conserve natural resources, minimize waste and pollution, and enhance overall sustainability. Additionally, it can improve the industry's reputation by demonstrating a commitment to sustainability and environmental stewardship. To successfully implement green supply chain management practices, effective coordination between various administrative levels within organizations is crucial.

Recommendations are made to support the implementation of green supply chain practices. These include finding environmentally friendly raw materials, adopting environmentally safe design and packaging practices, developing an annual training plan for employees related to green supply chain practices, and allocating a sufficient budget for scientific research in the field. These

recommendations aim to foster a more sustainable and environmentally conscious apparel industry in Sri Lanka by prioritizing sustainability and environmental stewardship.

DECLARATIONS

A. Study Limitations

Limitations of the study include its focus on the apparel manufacturing sector in Sri Lanka, which may limit the generalizability of the findings to other sectors. The study also examines only five green supply chain management practices and their impact on environmental performance, leaving room for further exploration of additional variables that influence environmental performance. Additionally, the research sample size was limited to a specific region and a small number of responses, which may affect the generalizability of the findings. Accessing the entire apparel supply chain was also challenging, resulting in a focus on employees in managerial and executive-level positions within sustainability departments. The study relied on primary data collected through questionnaires, further constrained by time limitations and a relatively smaller sample size.

B. Acknowledgements

It is with great pleasure the final research report is presented herewith but would not be completed without acknowledging the great people who were the pillars of support in making it a success.

Firstly, it is my foremost duty to pay my gratitude to my supervisor Ms. Anushka Gunawardana for granting her continuous support and dedication throughout this study. It was her gentle guidance with patience, motivation, enthusiasm, and immense knowledge that encouraged me to accomplish the successful completion of this research.

I would also like to give a special thanks go to all I would like to thank all the respondents for spending their valuable time assisting me with this research by responding to the questionnaire with much enthusiasm.

And also I'm grateful to the Department of Logistics and Transport, CINEC Campus, and all its academic

staff members and non-academic staff members for the tremendous service rendered throughout. Finally, I wish to express my gratitude and appreciation to all the members of my family s and friends for encouraging me to make this dissertation a successful one.

REFERENCES

1. Al-Odeh, M. & Smallwood, J., 2012. Sustainable Supply Chain Management: Literature Review, Trends, and Framework. *IJCEM International Journal of Computational Engineering & Management*, 15(1), pp. 85-90.
2. Amemba, C. S., Nyabokeye, P. G., Osoro, A. & Mburu, N., 2013. Elements of Green Supply Chain Management. *European Journal of Business and Management*, 5(12), pp. 51-61.
3. Amit, R. & Pratik, M. M., 2012. An Empirical Study Of Green Supply Chain Management Drivers, Practices And Performances: With Reference To The Pharmaceutical Industry Of Ankleshwar (Gujarat). *International Journal of Engineering and Management Sciences*, Volume 3, pp. 39-355..
4. Diab, S., Albourini, F. & Rumman, A. A., 2015. The Impact of Green Supply Chain Management Practices on Organizational Performance: A Study of Jordanian Food Industries. *Journal of management and sustainability*, 5(1).
5. Gil, M. Á., Jiménez, J. B. & Lorente, J. C., 2001. An analysis of environmental management, organizational context and performance of Spanish hotels. *Omega*, 1 December, 29(6), pp. 457-471.
6. Gupta, S., Davoodi, H. & Alonso-Terme, R., 1998. Does Corruption Affect Income Inequality and Poverty?. *IMF working paper*, 98(76).
7. Hervani, A., Helms, M. M. & Sarkis, J., 2005. Performance measurement for green supply chain management. *Benchmarking: An International Journal*, 12(4), pp. 330-353.
8. Jr, K. W. G., Zelbst, P. J., Meacham, J. & Bhadauria, V. S., 2012. Green supply chain management practices: impact on performance. *Supply Chain Management*, 12(3), pp. 290-305.
9. Kumar, R. & Chandrakar, R., 2012. Overview of Green Supply Chain Management: Operation and Environmental Impact at Different. *International Journal of Engineering and Advanced Technology (IJEAT)*, 1(3), pp. 1-6.
10. Lia, S., Ragu-Nathanb, B., Ragu-Nathanb, T. & Raob, S. S., 2006. The impact of supplychain management practices on competitive. *Omega*, 34(2), pp. 107-124.
11. Lin, C.-Y. & Ho, Y.-H., 2011. Determinants of Green Practice Adoption for Logistics Companies in China. *Journal of Business Ethics*, 98(1), pp. 67-83.
12. Li, Y., 2011. Research on the Performance Measurement of Green Supply Chain Management in China. *Journal of Sustainable Development*, 2 June.4(3).
13. Muma, B. O., Nyaoga, R. B., Matwere, R. B. & Nyambega, E., 2014. Green supply chain management and environmental performance among tea processing firms in Kericho. *International Journal of Economics, Finance and Management Sciences*, 2(5), p. 270.
14. Ninlawan, C., Seksan, P., Tossapol, K. & Pilada, W., 2010. The Implementation of Green Supply Chain Management Practices in Electronics Industry. *Proceedings of the International Multi Conference of Engineers and Computer Scientists*.
15. Pourjavad, E. & Shahin, A., 2018. The Application of Mamdani Fuzzy Inference System in Evaluating Green Supply Chain Management Performance. *International Journal of Fuzzy Systems*, 20(3), pp. 901-912.
16. Qinghua Zhu, J. S., 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of Operations Management*, pp. 265-289.

17. Rao, P. & Holt, D. L., 2005. Do green supply chains lead to competitiveness and economic performance *International Journal of Operations & Production Management*, 25(9), pp. 898-916.
18. Srivastava, S. K., 2001. Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews*, 9(1), pp. 53-80.
19. Storey, J., Godsell, J., Emberson, C. & Harrison, A., 2006. Supply chain management: Theory, practice and future challenges. *International Journal of Operations & Production Management*, 26(7), pp. 754-774.
20. Theyel, G., 2001. Customer and supplier relations for environmental performance. *Greener Management*, Volume 35, pp. 61-69.
21. Xiao, X., 2006. Green supply chain management in the UK and China. (Unpublished Masters Dissertation) University of East Anglia.
22. Younis, H., Sundarakani, B. & O'Mahony, B., 2020. Investigating the relationship between green supply chain management and corporate performance using a mixed method approach: Developing a roadmap for future research. *Iimb Management Review*, 32(3), pp. 305-324.
23. Zhu, Q. & Sarkis, J., 2004. Relationships Between Operational Practices and Performance Among Early Adopters of Green Supply Chain Management Practices in Chinese Manufacturing Enterprises. *Journal of Operations Management*, 22(3), pp. 265-289.
24. Zhu, Q., Sarkis, J. & Lai, K.-h., 2008. Confirmation of a measurement model for green supply chain management practices implementation. *International Journal of Production Economics*, 111(2), pp. 261-273.

A Study on the Barriers and Challenges for the Usage of Active Transportation in Sri Lanka

Ranawake. J¹, Siriwardene. S¹

¹Department of Logistics and Transport, CINEC Campus
roshan.siriwardnea@cinec.edu

ABSTRACT

Active transportation includes human-powered travel like walking, cycling, and skating. Active Transportation offers various benefits for users, society, and the economy in Sri Lanka. However it is not widely recognized as a primary commuting mode for daily travelers. This study mainly focuses on identifying potential barriers and potential challenges to the usage of active transportation in Sri Lanka and identifying the relationship between them especially focusing on the Colombo district. The study is limited only into the cycling because of the availability of data. The study has a quantitative approach and its cross-sectional study. A questionnaire was distributed physically and online to daily Colombo commuters for work, education and other purposes. Using convenience sampling, 384 responses were collected. The collected data were analysed by using IBM SPSS statistical tool. Most daily travelers to Colombo are males, with females fewer due to safety concerns while cycling. The majority belong to the millennial/Gen Z generation. Their trips prioritize work, followed by leisure activities. Few come for studies. The study has found four potential barriers and three potential challenges to the usage of active transportation. Identified barriers are infrastructure barriers, safety barriers, environmental barriers, and public perception about cycling. Identified challenges are costs related to cycles, air pollution, and educational aspects. It was also identified that there are negative relationships to the usage of active transportation in Sri Lanka from the above-mentioned barriers and challenges. As recommendations to future studies, it is better to look at other types of active transportation without limiting cycling focusing on the whole Sri Lankan context as this study is based only on Colombo. It will be good for future researchers can focus on the benefits and impact of potential barriers and challenges of active transportation.

This study also provides some recommendations like creating new transport policies to promote cycling in Sri Lanka.

Index Terms— Active Transportation, Potential Barriers, Potential Challenges, Cycling

INTRODUCTION

Active transportation, encompassing walking, cycling, and various non-motorized modes such as rickshaws, skateboards, and wheelchairs, serves both transportation and recreational purposes. (VTPI, 2010; gTKP, 2010). Diverse modes cater to different needs and communities, contributing to more efficient and equitable transportation networks. Within this system, walking and cycling stand out as the primary active transportation choices, with walking being an ancient mode of travel while cycling emerged roughly two centuries ago. Walking, the oldest form is as old as the species, while cycling, the second, is only about 200 years old. Researches have observed a clear decline in active transportation in from the end of the 20th century in most countries such as USA, UK, European countries and etc. In USA according to the national transportation survey data which is providing longitude data has shown that walking has fallen from approximately 9.3% in 1969 to only 8.6% of all recorded trips in 2001, although changes in survey methods suggest the earlier figure may be artificially low (Florida Department of Transportation and Center for Urban Transportation Research, 2006:4).

Specially in Sri Lanka cycling is not identify as a mode of transportation for commuters. Most of the middle class families own their vehicles so they can move from one place to another easily with the availability of fuel in the country. Sri Lanka's transportation system depends heavily on automobiles. This indicates that access to other modes of transportation is generally limited and that land use patterns and transportation

infrastructure primarily promote automobiles. Traffic congestion has become a huge problem in Sri Lanka. Mainly highly populated cities like Colombo, Kandy, and Gampaha are suffering from traffic congestion. In Colombo and other major cities, traffic congestion occurs during certain times of the day which are called speak periods or rush hours. The balance between the demand and the supply of road space is identified as the main two clear parameters which impact the creation of traffic congestion. (Amal , 2004).

As per Damunupola A.K.A (2021) challenges for cycling in Sri Lanka are categorized under 3 categories as safety and security, infrastructure facilities, and product and process related issues. Fernando, D. (2022) has stated that the barriers are included poor city planning in urban areas and excessive regulations in the country. Also many of the members of the workforce, living far away from their workplace and they have to have a convenient mode of transportation not only for reporting to work but also for other personal needs.

From early 2022, the government of Sri Lanka has suspended activities in oil refineries due to a shortage of crude oil inventories. Because of that people didn't get the chance to travel to fulfill their day-to-day work as they used to. Due to this situation, people started using active transport modes to full fill their basic short trips. As lots of people had to continuously queue up in fuel stations due to the fuel shortage, a lot of people moved bicycles and walking as their daily commutes. (Times of India, 22 July 2022). This has reduced traffic congestion as well as impacted the environment in a good way. But after the fuel crisis was solved, people again changed to using their private vehicles for cycling. It indicates that there's an issue for the usage of active transportation. Those issues can be either barriers or challenges which limits commuters from choosing active transportation as their mode of transport.

The main objective of the study is to identify the barriers to the usage of active transportation in Sri Lanka. The secondary objectives are to identify the barriers to implementing active transportation in Sri Lanka and identify the relationship of barriers and challenges with the usage of active transportation.

RESEARCH METHODOLOGY

Independent Variables

Dependent Variable

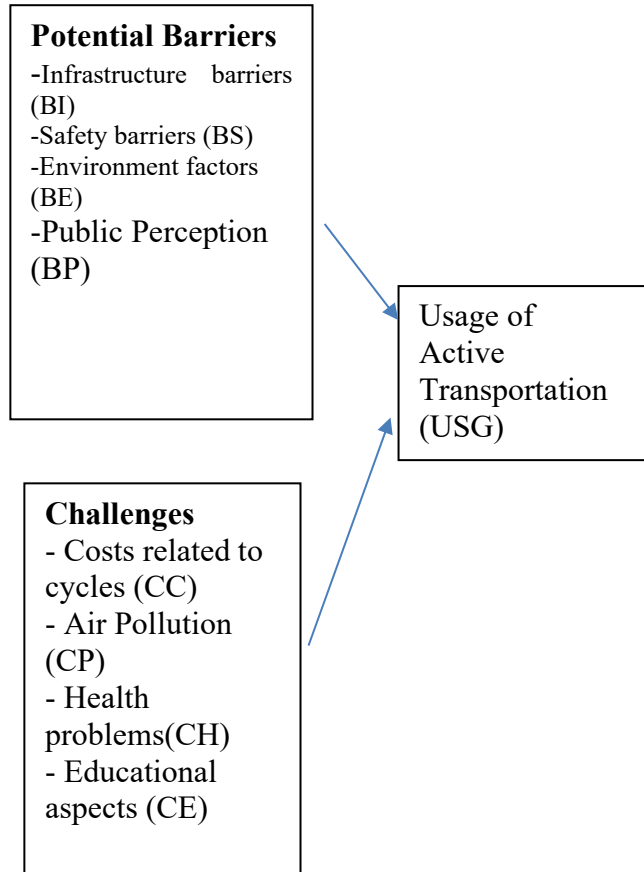


Figure 1 – Conceptual Framework

The conceptual framework for the study is developed based on literature review. Independent variables are derived from existing models and case studies, focusing on infrastructure, safety, environment, and public perception. Potential challenges include economic factors, air pollution, education, and health problems. The study's dependent variables include the frequency of cycling, likelihood to cycle in the future, and recommending cycling to others. The study area is the Moratuwa to Colombo fort stretch, chosen based on land use

patterns. The target population is daily commuters in the Colombo district, specifically those traveling from Moratuwa to Colombo fort along the Galle road corridor. The sample population, selected through convenience sampling, comprises individuals using active transportation. With a 95% confidence level and a 5% margin of error, data were collected from over 384 respondents. Convenience sampling was chosen due to Colombo's large population and the practicality of selecting participants from the Galle road corridor, allowing for a more detailed exploration of individual perspectives on active transportation.

The study collected primary data through a survey distributed among the sample population. The survey instrument was a questionnaire structured around the conceptual framework variables. The questionnaire had four categories: demographic factors, two categories related to independent variables, and a final category based on the dependent variable. Respondents used a likert scale to provide answers to questions related to the variables, allowing for a structured assessment of their perspectives.

Data Analysis

Factors affect to Barriers for active transport evaluate by using SPSS statistics package. Descriptive statistics are then applied to analyze answers to the questions on the identified barriers and challenges (mean, median, standard deviation, and frequency). To do the analyses, the variables relating to the identified barriers will be recorded in 5 categories;

Validity and the Reliability

To ensure the reliability of the scale in multiple likert scale questionnaire, cronbach's alpha is used. Questionnaire is considered to be more reliable to collect primary data pertaining to the survey, if cronbach's alpha co-efficient value is superior.

KMO and Bartlett's Test

The proportion of variances in the variables that might be caused by underlying factors, are indicated as a statistic in Kaiser-Meyer-Olkin (KMO) test. The higher values which are closer to 1.0 generally indicates that the factor analysis is useful with the data. If the values are less than 0.50, the factor analysis probably won't be useful.

Higher KMO value gives a higher correlation between variables. The test measures the sampling adequacy of each measure as well as the complete model. There are several rules of thumbs stated by the authors when applying the Kaiser-Meyer-Olkin (KMO) test

Bartlett's test, test for hypothesis that the correlation matrix is an identity matrix. It illustrates the redundancy between variables. The test is also utilized to create a solid relationship between variables. This test is used to determine the homogeneity of the variables. The test is also used to verify the assumptions, that variances are equal across groups or samples. If the KMO value is more than 0.7, Bartlett's test is also significant.

Reliability Test for Created Factors

Reliability of variables is are calculated by using cron batch alpha. Reliability test for the created factors and for the overall data set transcended the value of 0.6 of cronbach's alpha value demonstrating that the reliability of the variables is in an adequate level and data set can be analyzed.

Descriptive Analysis

Descriptive statistics tend to describe the basic features of the data in the study. The quantitative descriptions of the of the study is presented in a manageable form by the descriptive statistics. This research has utilized the responses of 384. This large amount of data is simplified in a sensible way through the descriptive statistics. This method is use to find frequency circulations, measures of mean, median, mode and also measure of variability. Also demographical factors of the research like age, gender, income level, educational level, purpose to travel to colombo are analyzed by using descriptive statistics.

Inferential Analysis

Regression analysis (Linear regression model and other diagnostic tests)

In this research regression analysis is utilized to examine the influence of one or more independent variables on the dependent variable. The method makes the study easier and flexible. The process of performing regression allows to confidently determine which factors matter the most, which

factor can be ignored and how the factors influence each other. Durbin watson test is carried out to find if there is a relationship with other variables. Regression model is having several assumptions. Regression model should be correctly specified. If there are 04 independent variables, that model should be specified for 04 independent variables as, $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4$ 5. Regression model should be linear Association between independent and dependent variables should be linear.

Model Summary

According to the model summary, multiple correlation is given by R. This indicates the strength of the joint association between independent variables and dependent variable, passenger satisfaction. Following decisions are taken based on the value of multiple correlation. If, $R \geq 0.7$ (Strong association) $R \geq 0.5$ (Average association) $R < 0.5$ (Weak association) Coefficient of determination is given by R square. That is the proportion of the dependent variable covered by the regression model is explained by R square and the value is always lying between 0 and +1.

Analysis of variance (Regression ANOVA)

Jointly significance of the result is tested using the ANOVA table. Probability of F test statistics should be significant ($P \leq 0.05$) to model to be appropriate indicating independent variables jointly influence on passenger satisfaction. If the probability of F test statistics is insignificant, the model is not valid.. Determination of the coefficients individual effect is tested by using coefficient table. If the probability values of the coefficient are significant, those variables are having individual effect also in addition to the jointly effect.

RESULTS

Table 1- Validity

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.85 1
Bartlett's Test of Sphericity	Approx. Chi-Square	111 7.1 42
	Df	36
	Sig.	.00 0

Source – Research Data

KMO (Kaiser-Meyer-Olkin) test is a measure of sampling adequacy used in factor analysis to determine if the data set is valid and suitable for factor analysis. Bartlett's test of sphericity, on the other hand, is a test of whether the correlation matrix between variables is significantly different from an identity matrix. Values closer to 1 indicate that the data set is highly valid for factor analysis,

In the table KMOL value is close to 1, It is 0.851, It shows the data is highly valid and suitable for the factor analysis.

The significance value of the table which also known as P value of the Barlett’s test is came as 0.000. From the results it can be identified that, the above value is lesser than the const and significance value of 0.05. It can be indicated that the validity and suitability of the responses collected to a study has being addressed through the study.

Anova

The probability of F test statistics of the regression ANOVA is highly significant. This means that the model is jointly significant. According to table, significant value (p-value) is equal to 0.00. It is less than the constant significant value 0.05, which means the ANOVA table is significant. Therefore, it can be

interpreted that independent variables jointly influence identify barriers and challenges which reduce the usage of Active Transportation. Hence this model is highly valid.

Table 2- Reliability

Variable	Cronbatch's Alpha	N items
Infrastructure Barriers	0.639	3
Safety Barriers	0.676	3
Environmental barriers	0.598	3
Public Perception	0.621	3
Costs related to cycles	0.632	3
Air Pollution	0.765	3
Health Problems	0.741	3
Educational aspects	0.721	3
Usage of Active transportation	0.748	3

Source- Research Data

When analyzing cronbatch’s alpha values , air pollution, health problems ,educational aspects and usage of active transportation (Dependent variable) have values more than 0.7. It has higher internal consistency and in highly acceptance level. Values for infrastructure barriers, safety barriers, public perceptions and costs related to cycles are over 0.6. Those also in acceptable level. Environmental barriers has a value of 0.598, even though it is less than 0.6, it is really closer for that value. So it can be interpreted that also this value can be accepted.

Since all the variables have values very close to 0.7, each of these eight (8) elements have an adequate value in terms of internal consistency, accuracy, and reliabilit

Table 3- Correlation Analysis

Independent Variables		Usage of Active Transportation
<i>Infrastructure Barriers</i>	Pearson Correlation	-.395**
	Sig. (2-tailed)	0.000
	N	389
Safety Barriers	Pearson Correlation	-.448**
	Sig. (2-tailed)	0.000
	N	385
Environmental barriers	Pearson Correlation	-.301**
	Sig. (2-tailed)	0.000
	N	387
Public Perception	Pearson Correlation	.330**
	Sig. (2-tailed)	0.000
	N	389
Costs related to cycles	Pearson Correlation	-.426**
	Sig. (2-tailed)	0.000
	N	389
Air Pollution	Pearson Correlation	-.441**
	Sig. (2-tailed)	0.000
	N	389
Educational aspects	Pearson Correlation	-.408**
	Sig. (2-tailed)	0.000
	N	389
Health problems	Pearson Correlation	-0.006
	Sig. (2-tailed)	0.902
	N	389
**. Correlation is significant at the 0.01 level (2-tailed).		

Source – Research Data

The table displays the correlations between independent variables and the dependent variable. With the exception of public perception, all independent variables exhibit negative correlations with the dependent variable. It indicates a decrease in active transportation usage. The strongest factor reducing active transportation is safety barriers (-0.448), while public perception shows a slight positive relationship. However, the impact of public perception on increasing active transportation usage is uncertain. Health problems are found to be insignificant and cannot be considered an independent variable affecting active transportation usage.

Table 4 – CORRELATIONS

Model		Unstandardized Coefficients	Std. Error	Significance
1	(Constant)	0.755	0.249	0.003
	Infrastructure barriers	-0.185	0.048	0
	Safety barriers	-0.242	0.051	0
	Environment barriers	-0.006	0.049	0.009
	Public Perception	0.008		
	Costs related to cycles	-0.077	0.059	0.019
	Air Pollution	-0.262	0.061	0
	Educational aspects	-0.171	0.057	0.003
a Dependent Variable: Usage of Active Transportation				

Source – Research Data

All the probabilities of above discussed six independent variables are highly significant with negative beta values. This shows that those independent variables influence negatively on the dependent variable which means they reduce the usage of active transportation. Only one independent variable has a positive beta value (public perception independent variable does not influence individually but can be influenced jointly).

Concerning the regression analysis and coefficient value, the study developed a function with their respective beta values. The function is illustrated as follows,

$$\text{Usage of Cycling} = 0.755 + (-0.185)\text{Infrastructure barriers} + (-0.242)\text{Safety barriers} + (-0.006)\text{Environmental Barriers} + (0.008)\text{Public Perception} + (-0.077)\text{Costs related to cycles} + (-0.262)\text{Air Pollution} + (-0.171)\text{Educational Aspects} + \epsilon$$

In the above-mentioned equation, the beta values of each independent variable show the one-unit change of the independent variables will have an impact on the dependent variable, usage of active transportation

Table 5
One Sample T Test (Testing Hypothesis)

	T	Sig. (2-tailed)	Mean Difference
Infrastructure Barriers	100.88	0	3.90488
Safety barriers	92.909	0	3.81662
Environment barriers	118.547	0	4.04861
Public Perception	109.577	0	3.46392
Costs related to cycles	96.897	0	3.73265
Air Pollution	93.588	0	3.65467
Educational Aspects	112.719	0	3.99572
Health Problems	101.54	0	3.77806
Usage of Active transportation	63.211	0	2.98029

Source – Research Data

From the above one sample test table, it can be shown that all significance values of independent variables are equal to 0.00. It means that they are lesser than the chosen level of significance 0.05. It indicates that null hypothesis related to the independent variables can be rejected and also can be concluded that the sample mean is significantly different from the hypothesized population mean.

From above interpretations following null hypotheses can be rejected.

- Potential barriers do not impact the usage of active transportation – H1,0
- Potential Challenges Factors do not impact the usage of active transportation – H3,0

Descriptive Statistics

All the means of the descriptive statistics are closer to the maximum statistics level and those means are above 3.5. It indicates that responses regarding variables are at an agreed level. The quantitative level of the likert scale is 1 -5. All the means are close to the likert scale 4.

The dependent variable, usage of active transportation has the highest standard deviation. It indicates that it has a comparatively higher variance. From independent variables, safety barriers have the highest standard deviation as it has a higher variance compared to other independent variables. Public perception has the lowest number of standard deviations, which indicates it has a variance.

Skewness levels are measured from -1 to +1. From skewness, it can be measured the asymmetry of a probability distribution. In descriptive statistics, it indicates the degree to which a distribution deviates from symmetry. In this statistic, all the skewnesses are having negative results. The majority of the observations in the dataset are concentrated towards the higher end of the scale and there are fewer observations towards the lower end. In other words, the data is lopsided towards the left. However since all the data are located within the range of -1 to +1, it can be said that this data has a normal distribution.

There are 3 negative kurtosis values in the data set for safety barriers, public perception, and health problems. It indicates that the distribution of those variables is flatter (more spread out). This means that the data values are more dispersed and have fewer extreme values (i.e., values that are much larger or smaller than the mean). The majority of the data values are clustered around the mean, with fewer values in the tails of the distribution. But absolute values of kurtosis are less than three times of standard error of kurtosis, it also shows that the data has normal distribution.

From the skewness values and kurtosis values, it can be interpreted that the data has a normal distribution, and therefore other tests (pearson correlations) can be carried out to analyze the data.

Although many researchers have concluded that barriers to transportation, few studies have investigated this relationship concerning cycling.

Some studies have shown either challenges or barriers to cycling. The results of this study showed both the potential barriers and challenges for cycling in the Sri Lankan context. As expected, the study has found relationships with potential barriers and challenges with cycling. Some studies, it has shown that a person's need for acceptance from family and social groups grows with their network size. The decision to cycle as transportation can be influenced by these groups' views. (Xing et al., 2010). Subjective norms play a significant role in the decision to commute by bike. Coworkers' cycling behavior and employer-provided financial incentives also impact bike usage. (Dill & Voros, 2007). Even this study, has identified that the income level of the people also impact to the active transportation as a barrier, specially people with higher income levels tend to use their own private vehicles. Perception of colleagues towards using cycling and Personal statuses which people likely to maintain also affect to the usage of active transportation.

Infrastructure barriers impact to cycling in 3 different ways according to the study. Land Use mix in Colombo City specially the enough space in the city, housing density, compactness, street interconnectivity, and the degree of land use mix are all influence to do active transportation (Badland et al., 2008). Present of cycle lanes on the road and limited parking for cycles in Colombo metropolitan area affect to choice of cycling. Due to the lack of bike lanes on the roadways, cyclists must share the same area with cars, and the absence of separation increases the risk to their safety. In a research conducted by Tin et al. (2010), 88% of participants stated that the presence of bike lanes would significantly increase their likelihood of cycling.

As the Environment barriers, distant from households to Colombo city and delays caused by high traffic conditions impact cycling. Based on a survey of Austin, Texas citizens, residents frequently drive to stores nearby since crowded roads make it hard to take a walk there. (Susan et al., 2001).

According to Mogaji, (2022), commuters in Lagos worry about the costs related to cycles, costs related to buying a good new bicycle as well as repairing costs of bicycles that can be used for

commuting. Also, there is an issue with the prices of safety gear to protect themselves when cycling. By conducting the study, it has been identified that this also affects Sri Lanka more than other challenges as this is a 3rd world country and the economic changes are so high. With the current economy of the country, all of these prices are getting higher, so it directly affects, people who have to spend more just for cycles from their income.

There are so many downloops in educating people about the usage of cycling in the current system in Sri Lanka. There aren't any programs for educating people about cycling practices and benefits. Also, in the school curriculum, there isn't any extensive training about safe and effective cycle techniques. In Danish schools, syllabuses are included with class lessons as well as training on roads. They first put kids cycling training tracks specifically made for children and then on regular cycling facilities all over the city (Pucher et al. 2010). Drivers should be educated about the safety of pedestrian users and cyclists. Because of these things education aspects also affect the usage of active transportation. Even if they violate traffic laws, drivers in Germany, Netherlands, and Denmark are nonetheless held liable for accidents with children and adult bikers. (Pucher & Buehler., 2008).

When talking about air pollution, misted and unclear polluted air, diseases which can be caused by exposure to air pollution and exhaust fumes by motorized vehicles make people think of using cycling as when using a cycle, commuters are always exposed to those things it can be imparted to them. When air quality declined, bicyclists were inclined to keep cycling if they felt more comfortable and safer. Fewer individuals commute by bicycle, policies aimed at encouraging a pleasant atmosphere for riding should be paired with the substantial investments made to improve bicycle infrastructure, as they are likely to be replaced by. (Zhao et al., 2018)

Chen. et al. (2016) shows that Chinese adults throughout the past twenty years, has been associated with an ongoing decrease in physical activity and a rise in poor diet, both of which boost the risk of developing these illnesses. Even though some studies have shown health problems as a challenge to do active transportation, in this

study it has shown that it doesn't directly implies with the Sri Lankan context.

CONCLUSION

Three out of the four potential barriers, excluding public perception, display a negative correlation with the usage of cycling in Sri Lanka, indicating that these variables diminish the utilization of cycling. Similarly, all three identified potential challenges show inverse relationships with cycling, suggesting a reduction in usage.

Future research would benefit from exploring other forms of active transportation, not solely focusing on cycling. This study was based in a segment of the Colombo district, and it would be advantageous for future research to encompass other districts in Sri Lanka, providing a comprehensive national context. It would be beneficial for these studies to concentrate on understanding the impact of potential barriers and challenges in active transportation, along with studies highlighting the benefits associated with it.

The study presents recommendations to promote cycling in Sri Lanka, as well as suggestions for conducting future research in this field. Geographical limitations and some demographic constraints were identified as limitations of this study.

DECLARATIONS

A. Study Limitations

There are some limitations to the generalisability of this study to the broader context. In this study only from the available modes of active transportation, Cycling has chosen to carry the study forward. As well, more in-depth discussion with different categories of active transport users (those who are confident/experienced, those who are inexperienced, etc.) is required.

Also, the study survey is conducted in the Galle road corridor from Moratuwata to Pettah which only covers a few cities in the Colombo metropolitan area to represent the Colombo District. Economic Levels will not be considered a barrier to choosing cycling as a mode of transportation.

B. Acknowledgements

I am thankful to every respondent who participated and spent their valuable time giving answers to the questionnaire and making this effective research.

Also, I'm grateful to the Faculty of Management, Humanities and Social Sciences, CINEC Campus, and all academic and non-academic staff members for the tremendous services rendered to every student throughout.

I owe my most generous appreciation and gratitude to my family and friends who are always there in my difficult times and pushing me to make it a triumph.

C. Informed Consent

I participant name, agree to participate in the research project titled project title, conducted by researcher(s) name who has (have) discussed the research project with me.

REFERENCES

1. E. P. Wigner, "Theory of traveling-wave optical laser," *Phys. Rev.*, vol. 134, pp. A635–A646, Dec. 1965.
2. Identify the CLIA's Efforts Towards to Mitigate the Environment Impact by Cruise Tourism Industry, Hansika Nirmani, Damsi Dharmaratne, Sampath Siriwardena, 2021. CINEC Campus.
3. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. [https://doi.org/10.1016/0749-5978\(91\)90020-t](https://doi.org/10.1016/0749-5978(91)90020-t)
4. Aranda-Balboa, M. J., Huertas-Delgado, F. J., Herrador-Colmenero, M., Cardon, G., & Chillón, P. (2019). Parental barriers to active transport to school: A systematic review. *International Journal of Public Health*, 65(1), 87-98. <https://doi.org/10.1007/s00038-019-01313-1>
5. Mathugamage, N., & Siriwardena, S. (2023). Analysis of the factors affecting to logistics service quality based on unaccompanied passenger baggage warehouses in sri lanka. *Dl.lib.uom.lk*. <http://dl.lib.uom.lk/handle/123/21613>

6. Badland, H. M., Schofield, G. M., & Garrett, N. (2008). undefined. *Health & Place*, 14(1), 85-95.
<https://doi.org/10.1016/j.healthplace.2007.05.002>
7. The bicycle compatibility index: A level of service concept, implementation manual. (n.d.). <https://rosap.ntl.bts.gov/view/dot/14487>
8. Broach, J., Dill, J., & Gliebe, J. (2012). Where do cyclists ride? A route choice model developed with revealed preference GPS data. *Transportation Research Part A: Policy and Practice*, 46(10), 1730-1740.
<https://doi.org/10.1016/j.tra.2012.07.005>
9. Chen, Y., Qin, P., Yu, Y., Zheng, S., Wang, Y., & Lu, W. (2019). The prevalence and increasing trends of overweight, general obesity, and abdominal obesity among Chinese adults: a repeated cross-sectional study. *BMC Public Health*, 19(1).
<https://doi.org/10.1186/s12889-019-7633-0>
10. Cole, R., Burke, M., Leslie, E., Donald, M., & Owen, N. (2010). Perceptions of representatives of public, private, and community sector institutions of the barriers and enablers for physically active transport. *Transport Policy*, 17(6), 496-504.
<https://doi.org/10.1016/j.tranpol.2010.05.003>
11. Cycling as a solution to fuel crisis. (2022, June 26). *Sunday Observer*.
<https://www.sundayobserver.lk/2022/06/26/news/cycling-solution-fuel-crisis>
12. Cycling to work in Colombo is easier said than done — Advocata institute. (2022, February 7). *Advocata Institute | Sri Lanka | Independent Policy Think Tank*.
<https://www.advocata.org/commentary-archives/2022/01/30/cycling-to-work-in-colombo-is-easier-said-than-done>
13. Damsara, K. D., De Silva, G. L., & Sirisoma, R. M. (2021). Analysis on transport mode choices of school children in Colombo district, Sri Lanka. *Engineer: Journal of the Institution of Engineers, Sri Lanka*, 54(0), 17.
<https://doi.org/10.4038/engineer.v54i0.7449>
14. Delso, J., Martín, B., & Ortega, E. (2018). Potentially replaceable car trips: Assessment of potential modal change towards active transport modes in Vitoria-gasteiz. *Sustainability*, 10(10), 3510.
<https://doi.org/10.3390/su10103510>
15. Department of census and statistics. (n.d.). Department of Census and Statistics. <https://www.statistics.gov.lk/ref/Riskmaps>
16. Eash, R. (1999). Destination and mode choice models for Nonmotorized travel. *Transportation Research Record: Journal of the Transportation Research Board*, 1674(1), 1-8. <https://doi.org/10.3141/1674-01>
17. Ewing, R., & Handy, S. (2009). Measuring the unmeasurable: Urban design qualities related to Walkability. *Journal of Urban Design*, 14(1), 65-84.
<https://doi.org/10.1080/13574800802451155>
18. Fishbein, M. (1963). An investigation of the relationships between beliefs about an object and the attitude toward that object. *Human Relations*, 16(3), 233-239.
<https://doi.org/10.1177/001872676301600302>
19. Foster, S., Giles-Corti, B., & Knuiaman, M. (2012). Does fear of crime discourage walkers? A social-ecological exploration of fear as a deterrent to walking. *Environment and Behavior*, 46(6), 698-717.
<https://doi.org/10.1177/0013916512465176>
20. Garcia Zambrana, I., & Khan, S. (2018). Active Transportation and Perceptions of Safety: A Case Study of a Regional Trail and a Transit Corridor in Salt Lake City, Utah. *Focus*, 14(1), 14.
21. Gatersleben, B., & Appleton, K. M. (2007). Contemplating cycling to work: Attitudes and perceptions in different stages of change. *Transportation Research Part A: Policy and Practice*, 41(4), 302-312.
<https://doi.org/10.1016/j.tra.2006.09.002>
22. Giles-Corti, B., Vernez-Moudon, A., Reis, R., Turrell, G., Dannenberg, A. L., Badland,

- H., Foster, S., Lowe, M., Sallis, J. F., Stevenson, M., & Owen, N. (2016). City planning and population health: A global challenge. *The Lancet*, 388(10062), 2912-2924. [https://doi.org/10.1016/s0140-6736\(16\)30066-6](https://doi.org/10.1016/s0140-6736(16)30066-6)
23. Gordon, C. (2018). Economic benefits of active transportation. *Children's Active Transportation*, 39-52. <https://doi.org/10.1016/b978-0-12-811931-0.00003-x>
24. Greves, H. M., Lozano, P., Liu, L., Busby, K., Cole, J., & Johnston, B. (2007). Immigrant families' perceptions on walking to school and school breakfast: A focus group study. *International Journal of Behavioral Nutrition and Physical Activity*, 4(1), 64. <https://doi.org/10.1186/1479-5868-4-64>
25. Guidebook for developing pedestrian and bicycle performance measures | Blurbs new | Blurbs | Main. (n.d.). <https://www.trb.org/Main/Blurbs/174295.aspx>
26. Handy, S., & Clifton, K. (n.d.). Planning and the built Environment: Implications for obesity prevention. *Handbook of Obesity Prevention*, 171-192. https://doi.org/10.1007/978-0-387-47860-9_8
27. Handy, S., Van Wee, B., & Kroesen, M. (2014). Promoting cycling for transport: Research needs and challenges. *Transport Reviews*, 34(1), 4-24. <https://doi.org/10.1080/01441647.2013.860204>
28. Heath, G. W., Brownson, R. C., Kruger, J., Miles, R., Powell, K. E., Ramsey, L. T., & _ . (2006). undefined. *Journal of Physical Activity and Health*, 3(s1), S55-S76. <https://doi.org/10.1123/jpah.3.s1.s55>
29. López-Lambas, M. E., Sánchez, J. M., & Alonso, A. (2021). The walking health: A route choice model to analyze the street factors enhancing active mobility. *Journal of Transport & Health*, 22, 101133. <https://doi.org/10.1016/j.jth.2021.101133>
30. MADHUWANTHI, R., MARASINGHE, A., RAJAPAKSE, R. J., DHARMAWANSA, A. D., & NOMURA, S. (2016). Factors influencing to travel behavior on transport mode choice. *International Journal of Affective Engineering*, 15(2), 63-72. <https://doi.org/10.5057/ijae.ijae-d-15-00044>
31. An, M., & Chen, M. (2007). Estimating Nonmotorized travel demand. *Transportation Research Record: Journal of the Transportation Research Board*,s 2002(1), 18-25. <https://doi.org/10.3141/2002-03>
32. (n.d.). MINISTRY OF TRANSPORT AND HIGHWAYS. https://www.transport.gov.lk/web/images/downloads/F-CoMTrans_Main_S.pdf
33. Mogaji, E. (2022). Cycling in Lagos: The challenges, opportunities, and lamprospects. *Transportation Research Interdisciplinary Perspectives*, 14, 100608. <https://doi.org/10.1016/j.trip.2022.100608>
34. More needs to be done to give push to cycling as travel option. (n.d.). Print Edition - The Sunday Times, Sri Lanka. <https://www.sundaytimes.lk/220821/news/more-needs-to-be-done-to-give-push-to-cycling-as-travel-option-492443.html>
35. Networks as connectors and Disconnectors. (2021, May 11). David Levinson, Transportist. <https://bit.ly/3NWAHeC>
36. Nielsen, T. A., Olafsson, A. S., Carstensen, T. A., & Skov-Petersen, H. (2013). Environmental correlates of cycling: Evaluating urban form and location effects based on Danish micro-data. *Transportation Research Part D: Transport and Environment*, 22, 40-44. <https://doi.org/10.1016/j.trd.2013.02.017>
37. Promoting a cycling culture in Sri Lanka - Opinion | Daily mirror. (2019, August 12). Daily Mirror - Sri Lanka Latest Breaking News and Headlines. <https://www.dailymirror.lk/Opinion/Promoting-a-cycling-culture-in-Sri-Lanka/172-172694>

38. Rabl, A., & De Nazelle, A. (2012). Benefits of shift from car to active transport. *Transport Policy*, 19(1), 121-131. <https://doi.org/10.1016/j.tranpol.2011.09.008>
39. Sri lankans turn to bicycles amid fuel shortage, skyrocketing prices - Times of India. (2022, July 12). The Times of India. <https://timesofindia.indiatimes.com/world/south-asia/sri-lankans-turn-to-bicycles-amid-fuel-shortage-skyrocketing-prices/articleshow/92824926.cms>
40. (n.d.). UC Research Repository. <https://ir.canterbury.ac.nz>
41. Şimşekoğlu, Ö., Nordfjærn, T., & Rundmo, T. (2015). The role of attitudes, transport priorities, and car use habit for travel mode use and intentions to use public transportation in an urban Norwegian public. *Transport Policy*, 42, 113-120.
42. Xing, Y., Handy, S. L., & Mokhtarian, P. L. (2010). Factors associated with proportions and miles of bicycling for transportation and recreation in six small US cities. *Transportation research part D: Transport and Environment*, 15(2), 73-81.
43. P. Kopyt *et al.*, "Electric properties of graphene-based conductive layers from DC up to terahertz range," *IEEE THz Sci. Technol.*, to be published, doi: 10.1109/TTHZ.2016.2544142. (*Note: If a paper is still to be published, but is available in early access, please follow ref [5].*)
44. R. Fardel, M. Nagel, F. Nuesch, T. Lippert, and A. Wokaun, "Fabrication of organic light emitting diode pixels by laser-assisted forward transfer," *Appl. Phys. Lett.*, vol. 91, no. 6, Aug. 2007, Art. no. 061103.

Original Article

COLREGs misunderstood or ignored?

S. Sankaranarayana¹, T. S. Wickramasinghe¹

¹*Department of Navigation, Faculty of Maritime Sciences, CINEC Campus,
shane@cinec.edu*

ABSTRACT

As various scholarly articles and accident investigation reports indicate, the risk of collisions at sea is still high. The objective of this research is to identify if this is due to misunderstanding of the International Regulations for Preventing Collisions at Sea 1972, as amended (COLREGs), by watchkeeping officers working onboard cargo ships.

A total of 76 collisions while navigating officers (OOW) were at the con that occurred during a period of 10 years were analysed.

80% of the collisions could have been avoided since one vessel was aware of the presence of the other. The highest number of collisions had taken place in cases of crossing situations. Furthermore, it is also important to note that 52% of the OOWs involved in collisions were sufficiently experienced.

No evidence was found to conclude that these accidents occurred due to misinterpretation or misunderstanding of the COLREG's by the OOW's onboard the cargo ships, but as incorrect or insufficient action had been taken by experienced OOW's, this could have been due to complacency and/or overconfidence on their part.

Among the measures to be taken to minimize collisions at sea, overconfidence and complacency are two factors that should also require attention by all interested parties.

Index Terms - COLREGs, Ship Collisions at Sea, Complacency and Over Confidence.

INTRODUCTION

When considering the ships of over 100 Gross Tonnage, Safety and Shipping Review [1] of 2022 states that, number of global maritime accidents/incidents from 2012 to 2021 have been

mainly caused by machinery damage or failure (9,968), followed by collision (3,134), contact (2,029), piracy (1,995) and fire/explosion (1,747). This indicates that collisions at sea are the second most common threat to safety, next to machinery damages of failures.

The objective of this research is to identify whether there were difficulties in understanding the International Regulations for Preventing Collisions at Sea 1972, as amended (COLREGs), by watchkeeping officers working onboard cargo ships, by analysing the facts which led to collisions during the period from 01/01/2012 to 13/12/2021.

Collisions which occurred whilst the Masters of both vessels were at the con have been excluded from this research, taking into consideration the experience they have on the practical application of the COLREG's over many years.

METHODOLOGY

A total of 76 Accident investigation reports of cargo ships involving navigating officers (OOW), issued by 11 major flag states were analysed. Though there were more than 76 accidents involving OOW at the con during the period considered, only 76 accident investigation reports were available for download from the Global Integrated Shipping Information System (GISIS) of the International Maritime Organization (IMO).

153 vessels were involved (including fishing vessels) in the said 76 collisions. All the collisions occurred between two vessels, except in one situation where a cargo ship collided with two fishing vessels.

DISCUSSION

A. Experience of the OOWs

In the graph below, experience is considered sufficient if the OOW had acquired at least 12 months

of sea experience in the capacity of OOW after obtaining the first Certificate of Competency (COC).

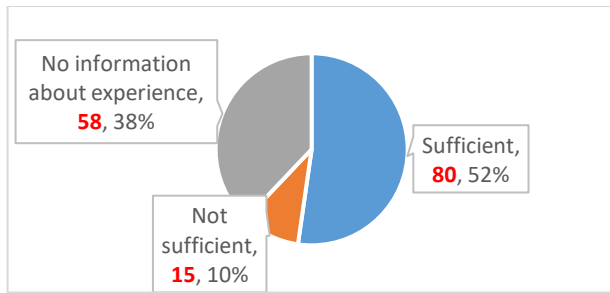


Figure 1 Experience of OOWs

When analysing the available facts, 52% of the OOWs involved were found to have sufficiently experienced. However, most scholarly articles state that a high number of collisions occur due to lack of experience of the OOWs. This may have changed over the past few decades due to the implementation of the ISM Code, STCW Code, efforts of the ship management companies and the efforts of the countries engaged in training of seafarers.

It is understood that this 76 accident investigation reports may not be sufficient for coming into a conclusion of identifying the connection between ‘experience’ and ‘collisions’. Since considerable number of the investigation reports on the GISIS cannot be downloaded, further analysis is required in this regard by parties having complete access to these accident investigation reports.

B. Situations that led to collisions

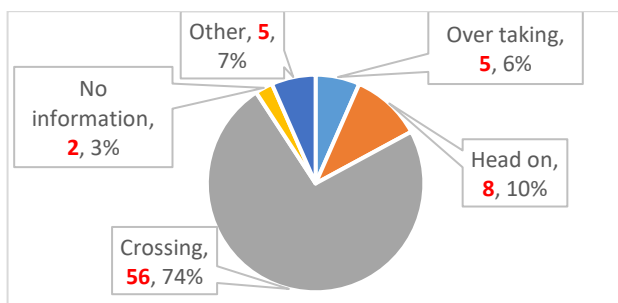


Figure 2 Situations that led to collisions

A very high number of accidents have occurred during crossing situations. Even though it was not evident from the casualty investigation reports, the reason could be that the probability of encountering crossing situations is higher than other situations, rather than misunderstanding or

misinterpreting Rule 15 and Rule 17 of the COLREGs. This view is further strengthened by the research conducted by Demirel & Bayer [2], where it was identified that the Rule 15 of COLREGs is not that difficult to understand.

As per the above graph;

- “No information’ includes situations where OOWs of both vessels involved in collisions were unaware of the other vessel until the collision occurred.
- ‘Other’ include one collision with an anchored vessel, two collisions with vessels drifting and two collisions due to breaching of Rule10 of COLREGs.

C. Collisions between cargo ships and fishing vessels

During the period considered, 36 fishing vessels were damaged or foundered after 35 collisions encountered with cargo ships. 143 fishermen had died or were declared missing. When considering fishing vessels, application of COLREG differs, depending on whether they were engaged in fishing or not. Therefore, it is important to identify with certainty whether these vessels were engaged in fishing or not at the time of collision, as it is otherwise to be construed as a collision between two power driven vessels.

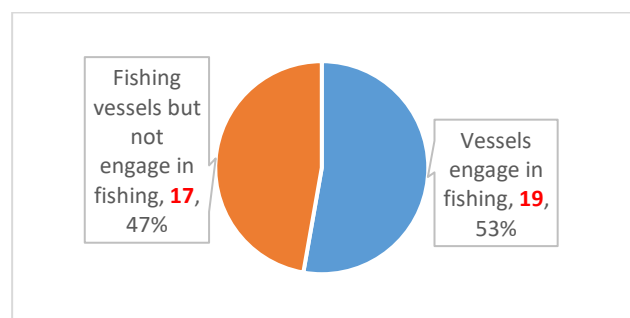


Figure 3 Collisions between cargo ships and fishing vessels

There is no appreciable difference of collisions between cargo ships and vessels engaged in fishing or not engaged in fishing. Further in accordance with the accident investigation reports there were no occasions where the lights and shapes were misunderstood by the OOWs of the cargo vessels.

When considering fishing vessels (engaged and not engaged in fishing), it is also important to note that there were a number of occasions where;

- the appropriate light signals and shapes were not displayed by the vessels.
- the Rule 5 was violated.
- the vessel had erratic manoeuvres prior to the collision and
- altered to port for power driven vessels on port side and noncompliance of other parts of Rule 17 being the ‘stand on’ vessel.

As the competency of watchkeepers onboard fishing vessels is beyond the scope of this research, it is not addressed further. But measures should be taken by Coastal States to carry out further research to identify the reasons for these collisions from the perspective of the fishing vessels while taking steps to enhance training on COLREGs for watchkeepers working onboard fishing vessels because of the high risk of collisions involved.

D. Awareness of the other vessel in the vicinity before the collision

The Steamship Mutual P & I Club [3] states that they regularly experience claims arising from collisions or other navigational errors, some of them large, where failure to maintain a proper and effective lookout often features as a proximate or contributing cause. Furthermore, the Seafarers International Research Centre [4] states that during 2002 and 2016, the most common immediate cause of collisions, close quarters and contact accidents were found to be the maintenance of an ‘inadequate lookout’. Similarly, considerable number of accidents considered in this research were also caused due to improper lookout. But, when the cause of a collision is categorized as ‘improper lookout’, the understanding of COLREGs and its application by the OOW cannot be analysed further. Therefore, for the purpose of this article, the awareness of the OOW regarding the presence of the other vessel was considered instead of considering whether Rule 5 was violated or not.

In the graph below, ‘Aware’ means the OOW was aware of the presence of the other vessel with sufficient time to take action to avoid collision.

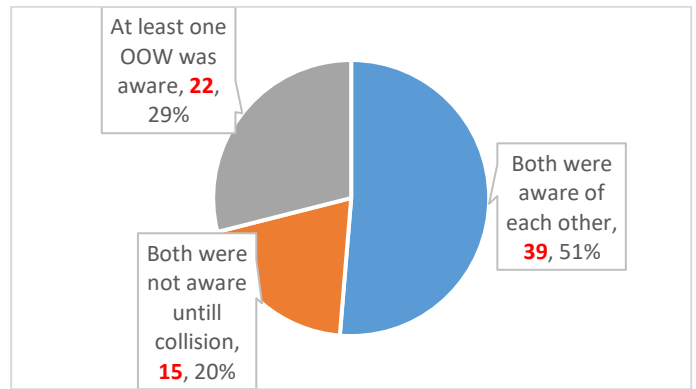


Figure 4 Awareness of the presence of the other vessel before the collision

Only 20% accidents had taken place without the knowledge of both vessels involved. Which means the remaining 80% could have been avoided since at least one OOW was aware of the presence of the other vessel, provided the OOW correctly followed the COLREGs.

If both vessels were not aware of the presence of the other vessel, understanding of the individual Rules in COLREGs cannot be verified. Therefore, other than in Rule 6 and Rule 19, these 20% of the collisions are not considered hereafter in this article.

E. Breaches of Rules in COLREGs

Below graph indicates breaches of Rules by the vessels involved in collisions other than Rule 13, Rule 14 and Rule 15 since they were discussed above.

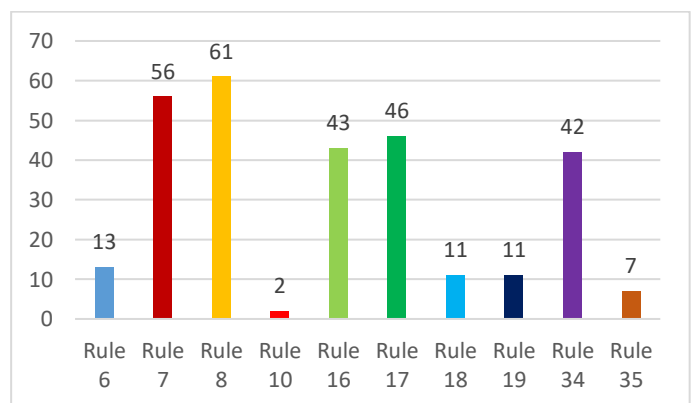


Figure 5 Breach by rule number

F. Rule 6 (Safe Speed)

Out of the 13 collisions which occurred due to maintaining an unsafe speed, 07 had occurred in restricted visibility.

In the case of Tenes [5] the judge said that it is well known with the assistance of an efficient radar

lookout, ships are proceeding at full speed in dense fog and agreed that continuing to proceed at full speed in dense fog after the presence of the other ships became known, were proceeding at unsafe speeds. Proceeding at full sea speed in restricted visibility when no traffic around in open ocean is not considered unsafe provided a good radar lookout is maintained. However, proceeding at full sea speed could be unsafe even when the visibility is good but heavy traffic is around.

No evidence was found in the accident investigation reports that the OOW had misunderstood Rule 6 specially when considering the experience of the OOWs involved. It was identified that lack of professionalism in the application of Rule 6 as a common mistake.

The officer in charge of the navigational watch shall notify the Master immediately if in any doubt [6]. Therefore, if the OOW cannot take a decision regarding the safe speed of the vessel, the Master shall be called before a risk of collision develops (in case the of a give-way vessel) or a close quarter situation develops (in case of a stand-on vessel).

G. Rules 7, 8 and 16

These three rules are discussed under one paragraph considering their connection to each other. On a considerable number of occasions, it appears there is misunderstanding or erroneous application of Rules 7, 8 and 16. In a nutshell, these Rules states;

- to identify the risk of collision (Rule 7)
- to take appropriate action in ample time (Rule 8) and
- the ‘give way’ vessel shall keep out of the way of the ‘stand on’ vessel (Rule 16)

Rule 7 & 8 applies to ‘give way’ vessels, ‘stand on’ vessels and vessels in restricted visibility, i.e., to all vessels.

In five occasions both vessels were involved in VHF agreements in order to avoid collision. That indicates that they had identified a risk of collision even though the actions taken were incorrect or insufficient. That is why there is a deference between the breaches of Rule 7 and Rule 8 on the graph above.

In number of occasions, the vessel involved in the collision was not even acquired on the ARPA. Without plotting, the next viable option to determine a risk of collision would be by taking a series of bearings of the target. This is not practicable under heavy traffic conditions and when quick decisions are required. ARPA plotting makes the application of Rule 7 easy. Therefore, the use of ARPA in identifying whether a risk of collision exists and/or a close quarters situation is developing is very important.

Though the ‘trial manoeuvre’ facility in ARPA can be used to decide the most appropriate action to take to maintain the required Closest Point of Approach (CPA), it has not been used in most of the cases studied in this research. This facility would be helpful in the application of Rule 8.

It is clear, when Rules 7 and 8 are not applied properly, application of Rule 16 and Rule 17 will not be effective, which could eventually lead to a close quarter situation or a collision.

‘Give way’ vessels and vessels in restricted visibility shall effectively identify whether there is a risk of collision and shall take effective action to avoid a close quarter situation in ample time. After assessing the risk, if the OOW on ‘give way’ vessel or in restricted visibility cannot take an effective action due to the presence of the other vessels and/or lack of navigable sea room, the Master shall be called without delay, as the Master also needs time to assess the situation before taking an action.

Except in 4 collisions there was a high possibility that most of the collisions could have been avoided had the master was called soon after the risk of collision was identified. In the cases studied, the Master was called only in a hand full of cases, and only when the collision was imminent and it was too late to avoid the other vessel.

Furthermore, the use of VHF radio communication to avoid collisions while manoeuvring is very common by Masters and marine Pilots. This is of course done making sure both the vessels are clearly identified and the final actions are clearly understood. One of the accident investigation reports states that the use of VHF radio communication as an aid for collision avoidance is strongly discouraged [7]. This might be very true when it comes to junior officers as the

agreed actions may be misunderstood due to language barriers.

When studying the cases involved, it was identified that insufficient action in accordance with these Rules contributed to the accidents, possibly due to overconfidence or complacency, rather than a misunderstanding of the COLREGs.

H. Rule 10 (Traffic Separation Schemes)

In total there were 08 collisions took place within Traffic Separation Schemes (TSS). Out of these collisions;

- 05 were while overtaking
- 01 when engaged in crossing
- 01 when a vessel had mistakenly entered the opposite traffic lane and
- 01 when a vessel had mistakenly entered the traffic separation zone while the other vessel was getting ready to pick a pilot.

Therefore, Rule 10 was violated only in two occasions (the last two mentioned above). These two accidents had taken place due to the lack of positional and situational awareness while experienced OOWs were on duty, therefore, misunderstanding of Rule 10 can be ruled out.

I. Rule 17 (Action by stand-on vessel)

In accordance with the Rule 17 of COLREGs the 'stand on' vessel may take an action to avoid the collision by her manoeuvre alone if she finds the 'give way' vessel is not complying with the Rules. When taking an action, the stand on vessel shall, if the circumstances of the case admit, not alter her course to 'port' for a power-driven vessel on her own port side.

This action may include change of speed or alteration of course to starboard. If the OOW on stand on vessel is not able to act as above due to various other factors, the Master shall be called before a close-quarter situation develops.

In the cases studied, the master was called only on few occasions, even then it was at the last moment where there was insufficient time to assess the situation. As mentioned above, in most of the cases, the OOWs were well experienced and

therefore cannot be considered that there could have been any problem in understanding the COLREGs, rather that the required actions were not taken.

Out of the total 46 accidents where the Rule 17 was breached, there were 21 incidents where the 'stand on' vessel had altered to port for power driven vessels on her own port side when taking actions in accordance with the section (a) part ii of Rule 17. Therefore, maritime trainers, ship management companies and ship Masters shall emphasize their trainees and OOWs to strictly not to alter course to port when taking an action in accordance with the Rule 17 (a)ii.

J. Rule 18 (Responsibilities between vessels)

10 out of the 11 collisions which occurred due to breaching Rule 18 had taken place with vessels engaged in fishing. Out of these 10 collisions, in 07 occasions, the actions of the fishing vessels may also have contributed to the collisions. These actions include;

- Not displaying correct light signals
- Alteration of course toward the ship
- Change of speed/course continuously at close range

The other collision occurred between a cargo ship and a tug which was engaged in towing operations. At the time of the collision, the tug was not exhibiting the 'restricted in her ability to manoeuvre' lights due to a defective light.

Therefore, it is hard to believe that there is a problem in understanding Rule 18. Most probable cause of breaching Rule 18 would have been inadequate or delayed actions required by Rules 7, 8, and 16.

K. Rule 19 and 35 (Conduct of vessels in restricted visibility and Sound signals in restricted visibility)

In this article, visibility is considered as restricted in situations where the visibility was reduced to three nautical miles or less. There were 11 collisions in such conditions, out of which 07 had taken place where at least one vessel was aware of the presence of the other vessel and the rest of 04 collisions had taken place while both vessels were unaware of the other. These 07 collisions could have been avoided had the OOW complied with Rules 6, 7, 8 and 19. Rules 6, 7 and 8

are not addressed further as those were discussed earlier.

Out of the 22 vessels involved in the 11 collisions, 16 vessels were cargo ships. Out of these 16 OOWs on cargo ships only 02 officers were inexperienced. Rule 19 was breached on one occasion by altering to port for a vessel forward of the beam while having sufficient sea room on starboard side, also by an experienced OOW.

Based on above facts, rather than misinterpretation of Rule 19, these collisions may have taken place due to incorrect action taken at that situation.

Rule 35 has not been complied with on 07 occasions and in other cases no information could be found. Due to proper structuring of the Rule 35, it is hard to believe that there are any complications in understanding of Rule 35.

L. Rule 34 (Manoeuvring and warning signals)

In accordance with the Rule 34 (d), if a vessel is in doubt regarding the actions of another vessel, she may give at least five short and rapid blasts on the whistle and the sound signal may be supplemented by light signals. As per the reports, in most of the cases, the 'stand on' vessel had used flashes to attract the attention of the 'give way' vessel but without any response from the latter. This could have been due to restrictions caused by blind sectors on certain cargo vessels and fishing vessels where the light signal may not have attracted the attention of the OOW or the other vessel may not have maintained a proper lookout by sight. Therefore, light flashes may not be seen by the other vessel and it would be more prudent for the OOWs to use whistle signals when at close range rather than light flashes to attract the attention of the other vessel.

As discussed earlier, a considerable number of accidents had occurred due to altering of course to port by the 'stand on' vessel for power driven vessels on her own port side. This may have been avoided if the 'stand on' vessel or the 'give way' vessel complied with Rule 34(a), before taking an action when a close quarter situation is developing to eliminate misunderstanding of the actions of each other.

M. Complacency and overconfidence

As most of the OOWs involved in collisions had sufficient sea experience and no information was available to say that the OOWs had misunderstood the COLREGs, ignoring the COLREGs may have contributed to the collisions. This may have led to incorrect or delayed actions, which could have been due to complacency and overconfidence.

Complacency is a deceiving and unwarranted satisfaction with a given level of proficiency, which leads to stagnation and unknowing deterioration of proficiency [8]. One may become complacent when engage in routine work and when becoming experienced specially when the same work is done over a long period of time without any incident. Since most of the accidents involving merchant ships had taken place while an experienced OOW was on duty, rather than misunderstanding, complacency may have taken an active part for the OOW to take incorrect actions.

In one of the accident investigation reports, an experienced OOW stated that she did not call the Master even when a fishing vessel was found to be heading towards her ship, assuming it would come closer and then veer off at the last moment to keep clear. In another case, a chief officer did not take effective action even after the lookout man informed him a few times of the presence of another vessel on the starboard side. If these are not complacency and overconfidence, what else would they be?

With no doubt, IMO has managed to reduce accidents at sea by;

- adopting the STCW Code with the aim of standardising the training of seafarers,
- adopting the ISM Code to reduce human error and
- introducing work and rest hours to minimise fatigue.

But accidents still occur at sea and these may be linked to complacency and overconfidence and this will lead to lack of situational awareness. Therefore, stakeholders of the industry must address complacency and overconfidence more widely than been addressed today. In order to eliminate complacency, MCA, UK [9] recommends the following;

- update situational awareness regularly
- get regular input from the team
- give/receive an effective briefing at handover
- actively look for problems
- use checklists effectively
- get help if don't understand a situation
- always follow company procedures
- never assume everything is working fine
- never expect something to be alright just because it always has been in the past

N. When to call the master

Among other situations, maritime trainers, ship managing companies and Masters shall urge their students and OOWs to call the Master;

- In cases of 'give way' vessel as soon as a risk of collision develops, and an appropriate action cannot be taken due to other ships in the vicinity and/or limited navigable waters.
- In cases of being the 'stand on' vessel, before a close quarter situation develops and an action cannot be taken due to the surrounding factors.

In the cases studied, some companies have provided instructions on their safety management system (SMS) with regards to minimum limits of CPA and Time to Closest Point of Approach (TCPA), where the Master is to be called in case the OOW is unable to maintain the required limits. These instructions were not followed by the OOWs in the cases studied. IMO has adopted the ISM Code and the SMS was implemented through ISM Code, aiming to minimize accidents due to human error, through the implementation of SMS onboard. Though it is the case, even at present there are accidents reported due to non-compliance of SMS. Again, this may be mainly due to the complacency and overconfidence on the part of watchkeeping officers which has led the objective of ISM code to be lost. Maritime trainers, shipowners and Masters shall educate the students and OOWs to strictly comply with the SMS.

Probably the industry may consider of setting the ARPA to plot all the vessels in a certain range automatically (OOW can un-acquire the targets which are not important), and if the OOW does not take an action prior to a pre-set time period and cannot maintain the pre-set minimum CPA and

TCPA limits (which may be adjusted by the Master) to generate an alarm automatically in the Master's cabin and appropriate places onboard.

Of course, the automatic plotting option is available on the ARPA, but the activation and the deactivation are at the OOW's discretion. ARPA will not automatically start plotting if that option is disabled by the OOW. Industry shall consider making this compulsory rather than keeping it as an option.

CONCLUSION

Highest number of collisions had taken place in cases of crossing situations. This may be because of the higher frequency of encountering crossing situations compared to over taking and head-on situations.

80% of the collisions could have been avoided as at least one vessel was aware of the presence of the other vessel and 52% of the OOWs involved in collisions were sufficiently experienced (had more than one year experience at sea after the first Certificate of Competency).

COLREGs are often misunderstood, misinterpreted, or just plainly ignored on frequent occasions [10]. No facts were found to prove the misunderstanding of COLREGs by OOWs onboard cargo ships. But most probably, the COLREGs were ignored.

As most of the collisions had occurred with an experienced OOW, this could be due to complacency and over confidence. This may require further research as the number of samples and statistics are insufficient. For the time being as the probability of accidents due to complacency and overconfidence is high, industry need to take immediate steps to address this issue.

Maritime trainers, shipowners and Masters shall encourage the OOWs to;

- comply with the SMS and COLREGs.
- use RADAR and ARPA when applying Rules 7 and 8.
- call Master in ample time.
- avoid VHF communication for collision avoidance unless at the presence of the Master.
- use appropriate sound signals when applying Rule 17 and when taking actions at close range.

Further, the shipowners, ship managers and IMO shall consider of;

- broadly addressing about the overconfidence and complacency,
- making it compulsory to use automatic acquisition zone on the ARPA rather than keeping it as an option for the duty officer to decide and to raise an alarm in the master's cabin and other appropriate places onboard if a pre-set CPA and TCPA limits cannot be maintained with the targets plotted on the ARPA.

REFERENCES

1. Safety and Shipping Review 2022, Allianz Global Corporate & Specialty, <https://www.agcs.allianz.com/content/dam/online/emarketing/agcs/agcs/reports/AGCS-Safety-Shipping-Review-2022.pdf> (Last accessed on 20/02/2023)
2. E. Demirel & D. Bayer, Further Studies On The COLREGs (Collision Regulations), The International Journal on Marine Navigation and Safety of Sea Transportation, Volume 9, Number 1, March 2015, (PDF) The Further Studies On The COLREGs (Collision Regulations) (researchgate.net) (Last accessed on 30/01/2023)
3. N. Paranjpye, Risk alert, Steamship Mutual Loss Prevention Bulletins, <https://www.steamshipmutual.com/sites/default/files/downloads/risk-alerts/RA71NavigationSafetyLookout.pdf> (Last accessed on 18/01/2023)
4. I. Acejo, H. Sampson, N. Turgo, N. Ellis, L. Tang, The causes of maritime accidents in the period 2002 – 2016, Seafarers International Research Centre (SIRC), CARDIFF University, https://orca.cardiff.ac.uk/id/eprint/117481/1/Sampson_The%20causes%20of%20maritime%20accidents%20in%20the%20period%202002-2016.pdf (Last accessed on 18/01/2023)
5. Judge J. Sheen, The Tenes, [1989] 2 Lloyd's Rep. 367
6. Para 40, Section A-VIII/2, STCW'78 as amended 2010
7. <https://safety4sea.com/avoiding-collisions-at-sea-risks-arising-from-the-use-of-vhf-ais/> (Last accessed on 30/01/2023)
8. Transport Canada, Complacency, 2018, <https://tc.canada.ca/en/aviation/publications/take-five-for-safety-tp-2228/complacency-tp-2228e-36> (Last accessed on 04/09/2022)
9. Maritime Coastguard Agency, MGN 520 (M), UK, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/837844/MGN_520_Final.pdf (Last accessed on 16/09/2022)
10. U. Acar, R. Ziarati, M. Ziarati, Collisions and groundings – major causes of accidents at sea, https://www.marifuture.org/Publications/Papers/Collisions_and_groundings_major_causes_of_accidents_at_sea.pdf (Last accessed on 30/01/2023)

Correlation of BMI With Educational Stress By Psychometric Analysis Via Perceived Stressed Scale In Non-State University Students

B.S. Gamage¹, N.G.I.A. Deraniyagala¹, K.M.D. Perera¹, A.A.K. Aishwarya¹, P.A.P.N. Perera¹, L.M. Hettihewa¹

¹Department of Biomedical Science, Faculty of Health Sciences, CINEC Campus

Menik.Hettihewa@cinec.edu

ABSTRACT

Overweight and Educational Stress had become two dominant problems in young population. We evaluated the effects of Educational Stress on BMI among non-state university students. Gender deference on stress and BMI, correlation between BMI and stress were determined. A google form was used for collection of data from 384 participants and stress was analyzed by Perceived Stress Scale (PSS). Majority of our study group 55.2% were female, and 44.8% were male. Mean BMI was 23.54kgm⁻² (Overweight) and it was 24.70kgm⁻² (overweight) in male and 22.60kgm⁻² (normal) in female. As per the PSS, 52% of male participant showed moderate stress and 48% male showed high perceived stress. In female population, 50% showed moderate stress, 47% showed high perceived stress and 3% showed minimum stress. Results show that >90% of students suffer from moderate to high perceived stress and it was positively correlated with BMI ($p=0.01$, $r=0.239$) seen in both genders. Educational stress can increase the students BMI and this finding is important for an institutional intervention for better outcome of the student performances. We recommend considering the program interventions to minimize the educational stress and to reduce the high BMI related non communicable diseases in future.

Index Terms — Perceived Stress Scale, Body Mass Index, Psychometric Analysis, University Students

INTRODUCTION

Obesity is a worldwide health complication and leading to many cardiovascular and other non-communicable diseases. In Obesity, body fat is synthesized to simple carbohydrates such as glucose and has been linked to an increase in lipid biosynthesis and, as a result, an increase in weight. Glucose is also responsible for the synthesis of fatty acids, which compose the body's fat content.

An increase in blood glucose levels leads to an increase in body weight hence the obesity through increased biosynthesis. Therefore, it is expected that obesity, and body mass index (BMI) are related to the blood sugar levels probably via the activity of insulin, which conserves energy while signaling the body to produce fat. This conservative anabolic activity of insulin can be impaired in high BMI in which the insulin receptor is covered ending up with potential insulin resistance, resulting in impaired blood sugar homeostasis [1-4]. Considering all relevant data, our research group investigated a possibility of using RBS as a predicting test to detect obesity in young generation.

Stress among undergraduate students;

Numerous worldwide studies had been conducted to assess the level of perceived stress among university students. [5-8] Mental deviation among university students had been identified with numerous impacts on the individual, family, and community. Undiagnosed or untreated mentally ill students have been identified at a high risk of dropouts from the academic program, losing their interest in studies, and depression, raising the unemployment rate that leads to extra burden on the families, society, and community as a whole [8]. Further, previous evidence had also demonstrated that academic stress decreases the student's academic performance that hinders the ability to study efficiently and better time management [11]

The Perceived Stress Scale (PSS) is a classic stress assessment instrument (6) and this tool was originally developed in 1983, remains one of the choice for researchers to study the effects of different situations affect feelings and our perceived stress. Therefore this scale was used in our study and investigated the level of feelings and thoughts. Participants were asked to indicate how often they felt or thought. BMI has been considered to measure the obesity in population [1-5]. Person's body fat composition has been changed with age. It has been found out that correspondence between BMI and body fat composition differs for both men and women [5]. For example, a man and

woman of the same height and weight may have the same BMI but women have higher body fat composition compared to men. Several studies with long term interventions, have shown that individuals who are overweight by BMI, had the same or better health profile when compared to participants with normal BMI [6]

Further, another research has indicated that academic stress impaired self-control and deteriorate health and food habit behaviors [7], and it had increased the risk of overweight and obesity. Another laboratory study has reported that college students had taken more carbohydrates, and sugars during the stress. [8]. Another study at different universities had revealed that academic stress had negative correlation with student's academic performance. [9] one interesting research had found out that academic stress is significantly higher among junior students than senior students. Factors had been justified as junior students are less experienced, have a low maturity level, and are more victimized by academic stress of university as compared to the seniors who are not only mature and experienced but also well adapted and well-adjusted to academic stress. [10, 13]

However, no study has been focused on the effects of academic stress on overweight and obesity among university students. Relationship of obesity with educational stress has not been investigated in Sri Lanka. Hypothesis was made to conduct epidemiological research to identify any association between obesity with higher educational stress. The Perceived Stress Scale (PSS) was used as psychometric evaluation tool for measuring the perception of stress in many studies. [6, 9] It measures the degree of stress, and each question has been designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives [11]. The PSS was designed for use in community samples and questions in the PSS analyze the feelings and thoughts, how often they felt [11-15]. There is no evidence in Sri Lanka in relation to the obesity with educational stress level. Therefore, this research will open the pathways to evaluating of many other research topics related to overweight and risks among young population.

Our main objective was to investigate any correlation between education stress with BMI/overweight/ obesity among young generation by using students between the ages of 20-27 years in Non-state universities, Sri Lanka.

RESEARCH METHODOLOGY

Details of the PSS standard scale were used to detect the data related to stress evaluation. The research surveillance questionnaire was developed as a google form. The final questionnaire was designed with sections: sociodemographic characteristics and the specific analysis section by the perceived stress scale (PSS-10) with 5-point scale adaptation. Google form consists of an information sheet, consent form, and the surveillance questionnaire of PSS. Student population of more than 1000 in the nonstate sector campuses will be selected to the study population. Google link was sent to students who were identified as university students in non-state universities in Colombo district. All the compulsory details about the study such as the aims, methods and contact information of the research were mentioned in the information sheet where the participant can direct their problems related to the study through an email and the obtained the consent. Validation of the questionnaire was done by study participants by administering via email to randomly selected expertise in two fields who are outside the define study population to vali.

METHODOLOGY

The study was approved by the Ethics review Committee on CINEC Campus. All students who gave the written consent to participate were given the google form. It provided the accurate values of Height, Weight and participants should follow the instructions below when taking their own measurements. All students who consented to the participation was recruited to the study.

Sample size

The total student population of students between the ages of 20 – 27 years in non-state universities was found of 110000 and 384 is the calculated sample size for the study.

Students were given instruction to measure height by using stadiometer and can get a helper to do the precise measurement. They were instructed to do several attempt for training to measure the height. Three measurements of height have to be taken to the nearest 0.1cm and mean height was calculated. Students should measure weight by using the electronic scale and the reading was taken to the nearest 0.1kg by using electronic scale. Mean of the three measurements of weight should be calculated.

Body mass index was calculated by the researchers using the BMI=Weight (kg)/Height (m²) formula. Table 1 shows the reference values of BMI for Sri Lankan guidelines.

Table 1 – shows the Sri Lankan reference values of categories of BMI.

BMI Category	Sri Lankan BMI cut off levels
Under weight	< 18.5
Normal	18.5 – 22.9
Overweight	23.0 - 24.9
Obesity class 1	25.0 – 30.0
Obesity – class 2	30.0 – 35.0
Obesity	class >35

Stress Assessment Scale

The scale includes a number of direct queries about current levels of experienced stress. The perceived stress scale (PSS)-10 (9) is the most widely used and validated psychological instrument for measuring the perception of stress [10]. The PSS-10 includes direct queries about current levels of experienced stress. The questions in the PSS ask about the feelings and thoughts of the last month. Scale indicates, 1 for No, 2 for relatively low, 3 for average/general, 4 for relatively high, and 5 for extremely heavy. Responses in items 4, 5, 7, & 8, was considered in reverse scoring system (e.g., 0 = 5, 1 = 4, 2 = 3, 3 = 2 & 4 = 1, 5=0) and marks were summed. Total scores were obtained by summing all the scale items with a total score range between 0 and 40. Final scores ranging from 0-13 would be considered minimum stress, 14-26 would be considered moderate stress, and 27-40 would be considered high perceived stress.

Data analysis

Means and SD were calculated for each variable using descriptive statistics. Relevant descriptive statistics (frequency, central tendency, variation) will be calculated. A Chi-square test (for categorical variables) and ttests (for continuous variables) were conducted to test for the differences of perceived academic stress across gender.

RESULTS AND DISCUSSION

Mean age of our study population is 23 years (SD±1.18) and 55% of them were female. Mean

height was 1.63m (SD±0.095) and mean weight was 62.53 Kg (SD± 11.98)

Figure 1 shows the distribution of weight among participants.

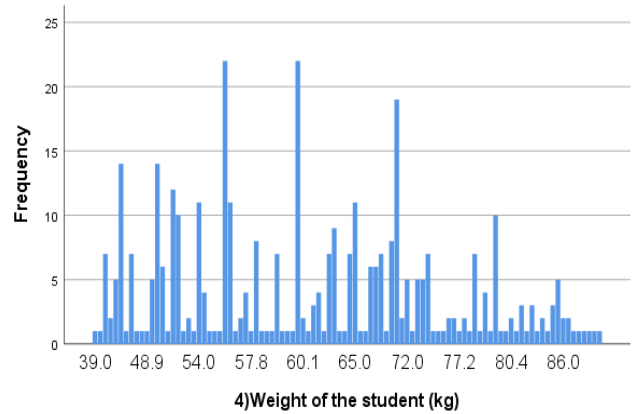


Figure 1 -Distribution of weight among participants.

Figure 1 shows the distribution of the weight from 39 Kg to 87kg. Data represents mean of three measurements.

Figure 1 shows the distribution of the weight among the participants. The mean weight of the sample was 62.5 kg (SD± 11.9413) and minimum weight was 39 kg and the maximum weight was 100 kg

BMI category of our study population

We analyzed the distribution of BMI group in study population as per the Sri Lankan BMI categories. Mean BMI was 23.5 Kgm⁻² (SD±3.51) in our study population and BMI varied between 16.16–34.93 Kgm⁻² among the study population, with a mean value of 23.54 Kgm⁻² (SD ± 3.52).

Figure 2 shows 38.5% of student were in normal BMI and 32.8% of them were obesity class 1 category and interestingly we could not find participants within the Obesity class 3 (BMI level >35).

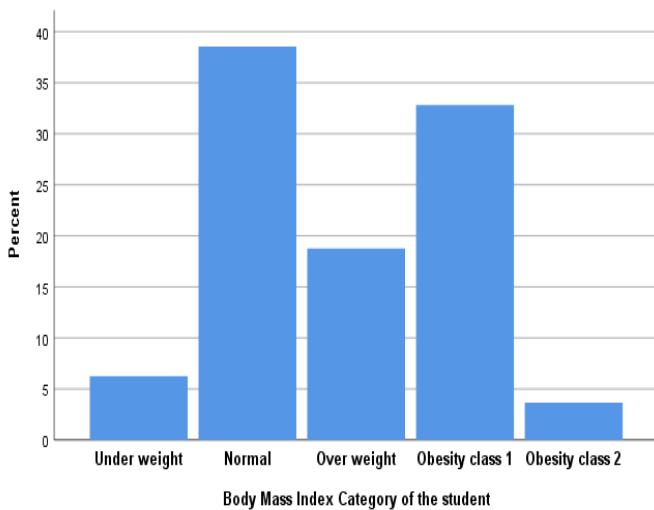


Figure 2 - percentage of our participants

Figure 2 shows the percentage of our participants belongs to the different category of BMI. 38.5% of student normal category (BMI 18.5 – 22.9); (n = 142) and 32.8% of them were obesity class 1 category (BMI 25.0 – 30.0); (n = 126). 18.8% (n=72) participants were overweight BMI category (BMI level 23.0-24.9). 6.3% of participants are underweight category (BMI level < 18.5); (n=24) and); 3.6% of them were obesity class 2 (BMI level 30-35(n=14). There were no participants within the Obesity class 3 (BMI level >35).

Descriptive statistics of stress level evaluated by the Perceived Stress Scale

Our results showed that The PSS Scale varied between 10–39 among the study population, with a mean value of 26.72 (SD±5.5). Table 2 shows that different stress level as per the perceived stress scale analysis.

Table 2 - different stress level by the PSS analysis.

Category	Frequency	Percentage
Minimum stress	6	1.6%
Moderate stress	196	51.0%
High perceives stress	182	47.4%
Total	384	100%

Table 2 shows the percentage of our study population in different level of stress analyzed using Sri Lankan figures. Majority of students had moderate stress (level 14–26); 51.0% (n=196).

47.4% of participants were under the high perceived stress (level 27–40); (n=182). Only 1.6% of students are ranged within the minimum stress level category (level 0-13); (n=6).

Correlation between BMI and PSS Scale stress level

Pearson correlation test was done statistically to find out the correlation between BMI and PSS level. According to our results, there is a moderate positive correlation between BMI and PSS level (r=0.24, p>0.001)

Following table 3 and the Figure 3 shows how the different MBI group participants level of stress analyzed by perceived stress scale.

Table 3 Correlation of BMI with PSS stress level

Correlations	Body Mass Index Value of the student	Perceived Stress Scale value of the student
6)Body Mass Index Value of the student	Pearson Correlation	.239**
	Sig. (2-tailed)	.000
	N	384
8)Perceived Stress Scale value of the student	Pearson Correlation	.239**
	Sig. (2-tailed)	.000
	N	384

** . Correlation is significant at the 0.01 level (2-tailed).

Following Figure 3 shows different stress level analyzed by perceived stress scale.

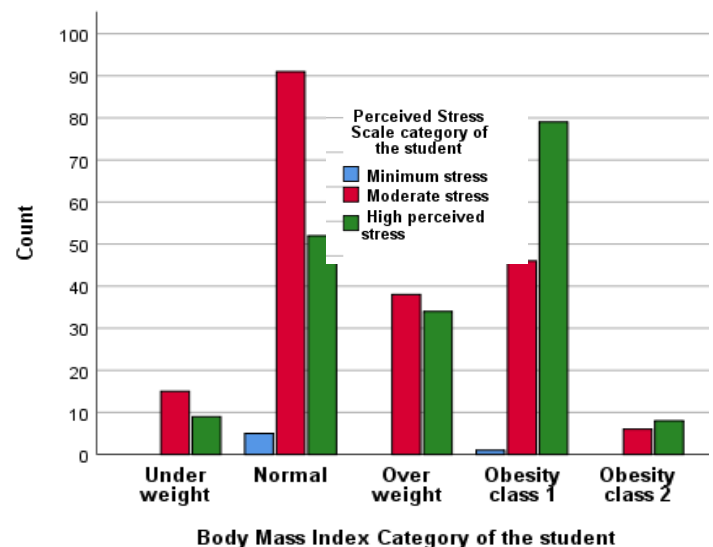


Figure 3 different stress level

Figure 3 shows 20.6% of Obesity class 1 category related with high perceived stress level. 23.7% of normal BMI category were found to have moderate stress level. 13.5% of (n=52) students were belong to normal BMI level with High perceived stress. 12.0% (n=46) of students were belong to obesity class 1 under the moderate stress.

Gender difference with BMI category

According to analysis, among total sample of female (n=212) majority of female; 27.6% (n=106) were belong to normal BMI Category and 30% of female (n=50) were belong to obesity class 1.

8.3% of female (n=32) were overweight and 4.9% of females (n=90) were underweight. Most importantly, 1.3% (n=5) females were belong to obesity class 2. Among total sample of male (n=172) majority of male; 19.8% (n=76) were obese class 1 and 10.9% of male (n=42) showed Normal BMI. Another 10.4% (n=40) of male were overweight. As a smaller percentage of male, 2.3% (n=9) and 1.3% (n=5) were belong to obesity class 2 and underweight respectively. Most importantly, we could not find students for class 3 obesity category.

Finally, although number of females are high in total participant sample, high number of males (n=125) were not in normal BMI range than the females. (n=87).

Figure 4 shows the different values of the BMI categories both in male and female study population

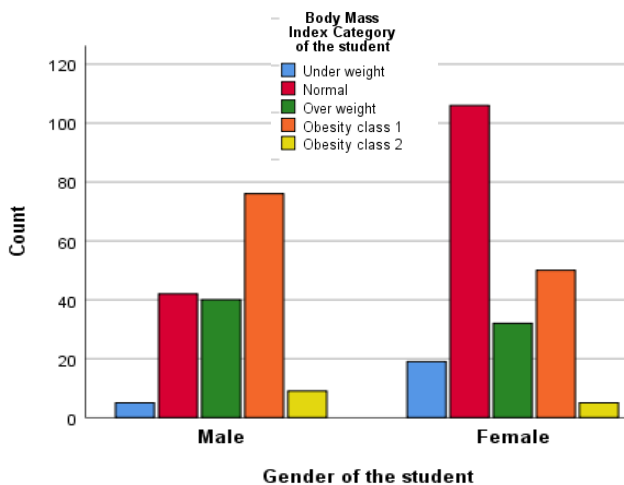


Figure 4 - the different values of the BMI categories both in male and female study population.

According to our research analysis, majority of male and female were belonging to moderate stress and high perceived stress. 27.6% (n=106) of female showed moderate stress and 26.0% (n=100) female showed high perceived stress scale.

In compared to previous results, males 23.4% (n=90) showed moderate stress and 21.4% (n=82) showed high perceived stress. No males participants showed with minimum stress but 1.65% of female (n=6) had minimum stress.

As per our comparison study, male and female result showed that both has considerable stress which was not depending on gender. (Figure 5)

Figure 5 shows female participants showing higher perceived stress compared to males in number and strength



Figure 5 – figure 5 shows the level of perceived stress both in female and male group

BMI AND PERCEIVED STRESS SCALE CROSS TABULATION

According to this analysis, 20.6% of Obesity class 1 category showed high perceived stress level and 23.7% of normal BMI showed moderate stress level. 13.5% of (n=52) students showed normal BMI level with High perceived stress. 12.0% (n=46) of student were belong to Obesity class 1 under the Moderate stress. This results showed that high perceived stress is observed in obesity class 1.

Table 3 - results of BMI with perceived stress level of our study population

BMI Category	Perceived Stress Level Category		
	Minimum stress (0-13)	Moderate stress (14-26)	High perceived stress (27-40)
Under weight (<18.5)	0 (0.0%)	15 (3.9%)	9 (2.3%)
Normal (18.5-22.9)	5 (1.3%)	91 (23.7%)	52 (13.5%)
Over weight (23.0-24.9)	0 (0.0%)	38 (9.9%)	34 (8.9%)
Obesity class 1 (25.0-30.0)	1 (0.3%)	46 (12.0%)	79 (20.6%)
Obesity class 2 (30.0-35.0)	0 (0.0%)	6 (1.6%)	8 (2.1%)
Obesity class 3 (>35.0)	-	-	-

CONCLUSION

We identified majority of students have moderate to high degree perceived stress during this undergraduate period. In addition to that this perceived stress is positively correlated with the body mass index. This is an interesting finding which is very important to plan institutional level intervention program for all students who perceive higher education and needs urgent action plan for to reduce the level of stress. As institutions, we can strongly recommend considering evaluated intervention program to minimize the educational stress which can also reduce the high BMI related non communicable diseases in future.

DECLARATIONS

A. Study Limitations

This study was conducted only in non-state universities of the Sri Lanka and we found it as a limitation factor we expect to expand this study for all students in higher education in Sri Lanka and analyze the data.

B. Acknowledgements

Our group acknowledge all the staff in the Faculty of Health Sciences for the extended support in this regard.

C. Funding source if any

None.

D. Conflict of Interests

None

E. Human and Animal Related Study - NA

F. Ethical Approval

Research proposal was approved by the CINEC Ethics review Committee and the approval number is

G. Informed Consent

All participant were given the informed consent to publish this research work.

REFERENCES

1. Al Bshabshe A, Al-Ghamdi MA, Elkhaliifa MI, Ahmad MT, Eljack IA, Assiri YM, et al. Weight status and related factors in medical students of King Khalid University, Saudi Arabia. *Saudi J Obesity*. 2018;6:35–40
2. Appannah, G., Safiza, N., Khor, G. and Kee, C. (2009). Reliability, technical error of measurements and validity of instruments for nutritional status assessment of adults in Malaysia. *Singapore medical journal*, 50(10), pp.1013-1018
3. Cilliers, J., Senekal, M., Kunneke, E.(2005) „The association between the body mass index of first-year female university students and their weight-related perceptions and practices, psychological health, physical activity and other physical health indicators“. *Public Health Nutrition* 9(2), 234-243.
4. Katulanda, P., Jayawardena, M.A.R., Sheriff, M.H.R., Constantine, G.R. and Matthews, D.R., 2010. Prevalence of overweight and obesity in Sri Lankan adults. *Obesity reviews*, 11(11), pp.751-756
5. Page, A., Fox, K. (1998) „Is body composition important in young people’s weight management decision-making? “. *International Journal of Obesity and Related Metabolic Disorders* 22(8), 786 – 92.
6. Program, S. O. N. H. E. A. (2020). Perceived Stress Scale. Retrieved from <https://das.nh.gov/wellness/docs/percieved%20stress%20scale.pdf> (accessed June 1, 2020).
7. Weidner, G.; Kohlmann, C.W.; Dotzauer, E. The effects of academic stress on health behaviors in young adults. *Anxiety Stress Coping* 1996, 9, 123–133

8. Emond, M.; Eycke, K.T.; Kosmerly, S.; Robinson, A.L.; Stillar, A.; van Blyderveen, S. The effect of academic stress and attachment stress on stress-eaters and stressundereaters. *Appetite* 2016, 100, 210–215
9. Cohen S, Kamarck T, Mermelstein R J *Health Soc Behav.* A global measure of perceived stress. 1983 Dec; 24(4):385-96.
10. Tariq S., Tariq S., Tariq S., Jawed S. (2020). Perceived stress, severity and sources of stress among female medical students in a private medical college in Pakistan. *JPMA* 2019, 162–167. 10.5455/JPMA.2153
11. Worku D., Dirriba A. B., Wordofa B., Getahun F. (2020). Perceived stress, depression, and associated factors among undergraduate health science students at arsi University in 2019 in Oromia, Ethiopia. *Psychiatry J.* 2020, 1–8. 10.1155/2020/4956234
12. Khan M. J., Altaf S., Kausar H. Effect of perceived academic stress on students' performance. *FWU Journal of Social Sciences.* 2013;7(2):146–15
13. Aldiabat K. M., Matani N. A., Navenec C. L. Mental health among undergraduate university students: a background paper for administrators, educators and healthcare providers. *Universal Journal of Public Health.* 2014;2(8):209–214
14. Karyotaki E., Cuijpers P., Albor Y., Alonso J., Auerbach R. P., Bantjes J., et al. . (2020). Sources of stress and their associations with mental disorders among college students: results of the world health organization world mental health surveys international college student initiative. *Front. Psychol.* 11:1759. 10.3389/fpsyg.2020.0175
15. Manzar M. D., Salahuddin M., Peter S., Alghadir A., Anwer S., Bahammam A. S., et al. . (2019). Psychometric properties of the perceived stress scale in Ethiopian University students. *BMC Public Health* 19:41. 10.1186/s12889-018-6310-z
16. Waters E, de Silva-Sanigorski A, Burford BJ, Brown T, Campbell KJ, Gao Y, Armstrong R, Prosser L, Summerbell CD. Interventions for preventing obesity in children. *Cochrane Database of Systematic Reviews* 2011, Issue 12. Art. No.: CD001871. DOI: 10.1002/14651858.CD001871.pub3. Accessed 19 June 2021
17. Noel Somasundaram, Ishara Ranathunga, Kavinga Gunawardana, Muneer Ahamed, Dileepa Ediriweera, C. N. Antonypillai, Nishan Kalupahana, "High Prevalence of Overweight/Obesity in Urban Sri Lanka: Findings from the Colombo Urban Study", *Journal of Diabetes Research*, vol. 2019, Article ID 2046428, 9 pages, 2019. <https://doi.org/10.1155/2019/2046428>

Original Article

Effect of Quarry Dust in Compaction Characteristics of Loose Sandy Soil from a Local Paddy Field

Senanayaka S. K. S. M. S. I¹, Diyes G.H.I¹, Walpita S.C¹

¹Department of Civil Engineering, Faculty of Engineering Technology, CINEC Campus, Malabe, Sri Lanka
supun@cinec.edu

ABSTRACT

Loose Soils found in locations such as paddy fields deemed as unsuitable for construction works in general. Loose sandy soil is characterized by its granular and non-cohesive structure, which results in a high porosity and low bulk density. In construction, achieving adequate compaction is essential for enhancing the load-bearing capacity and stability of the soil. Therefore, if the geotechnical properties of these soils can be improved using a waste material such as quarry dust, which is a byproduct of the construction aggregate crushing process, it can offer a significant advantage. This study aims to assess the effect of quarry dust in maximum dry density and optimum moisture content of sandy soils from a local paddy field. Quarry dust is mixed with the soil in proportions of 10%, 20%, 30%, 40% & 50% by weight. Laboratory tests such as sieve analysis, specific gravity, Atterberg limit and proctor compaction tests were conducted on soil and soil – quarry dust. The results indicated that maximum dry density continues to increase with the addition of quarry dust while optimum water content reduces up to the addition of 30% quarry dust. The findings support that compaction characteristics can be improved using quarry dust which increases the suitability of the soil for construction purposes.

Index Terms- Sandy Soil, Quarry Dust, Paddy Soil, Soil Compaction, Maximum Dry Density, Optimum Water Content

INTRODUCTION

As the construction industry experiences rapid growth, the effective and optimum use of available resources becomes paramount. Currently, weak soils from paddy fields are rarely employed for

meaningful purposes in construction. Loose sandy soil found in local paddy fields is one such example. If the geotechnical properties of such soils can be improved using waste materials such as quarry dust, it certainly can contribute to the sustainable use of resources.

Paddy soils play a crucial role in supporting agricultural practices, but often present challenges when it comes to construction activities. Loose sandy soil within paddy fields presents a unique set of considerations for civil engineers and construction professionals due to its unstable nature [1].

Quarry dust is a solid waste material generated during the process of crushed aggregate production. Quarry dust shows significantly high shear strength which is extremely advantageous in improvement of geotechnical properties of soil [2]. There are a number of useful geotechnical applications available for quarry dust such as embankment backfills and as road sub-base material in large quantities.

In a soil –quarry dust mix, the optimum moisture content tends to decrease while maximum dry density tends to increase as the quarry dust percentage increases. This is mainly attributed to the presence of coarser solid particles and high specific gravity of quarry dust. In addition, particles size distribution curves may exhibit more well graded behavior with the addition of quarry dust, depending on the soil type. This could also lead to aforementioned characteristics in optimum moisture content and maximum dry density [2] [3].

In addition to compaction characteristics, there are several soil properties soil that can be enhanced

with the usage of quarry dust. When quarry dust is mixed with expansive soil it influences swelling behavior and reduces free swell strain. Also the addition of quarry dust results in the reduction of Plastic limit, Liquid limit and Plasticity index. [4]

Increased quarry dust content results in increment of shear strength in soil. Quarry dust possess a relatively higher Friction angle and hence tend to increase the overall friction angle of soil quarry dust mix. However the opposite can be observed when it comes to cohesion, due to lack of cohesion among quarry dust particles. [5][6]

Addition of Quarry dust content also enhances the California bearing ratio (CBR) of soil. Higher CBR values can be observed when quarry dust percentage is increased up to 60 % of the soil-quarry dust mix. No significant improvement in CBR can be detected beyond 60%. [2][6].

As the literature suggest, several geotechnical properties of range of soils can be improved with the addition of quarry dust. This paper mainly focuses on the compaction properties and hence aims to identify the effect of quarry dust in maximum dry density and optimum moisture content, when mixed with loose sandy soils obtained from a local paddy field.

RESEARCH METHODOLOGY

In the beginning, the quarry dust and sandy soil were tested separately to identify their properties. The tests conducted were liquid limit tests, specific gravity tests, particle size distribution tests and compaction tests. All the tests were done following the BS standards.

A. Materials

Sandy soil collected from a paddy field in the vicinity of Borelasgamuwa area (Colombo district). This particular location has been selected due to the soil's high content of medium to fine sand, as depicted in fig. 1. Quarry dust is produced from aggregate crushing process (size range 0mm-10mm) used as the material to be mixed with the sandy soil.

B. Test Procedure

1) Sieve analysis

BS sieves with varying mesh sizes (10mm, 5mm, 2.36mm, 0.6mm, 0.3mm, 0.15mm) were systematically arranged for the test. Figure 1 shows a graph on a semi-log sheet. It displays the sieve sizes and percentage mass passing data. Sieve analysis test was done quarry dust and paddy sand separately.

2) Specific gravity test

The specific gravity test was carried out for both sandy soil and quarry dust. The tests were conducted adhering to the ASTM D854 standard. The results are shown in table 2.

3) Atterberg Limit test

The liquid limit test and plastic limit tests were conducted separately for sandy soil and quarry dust, according to the standard ASTM D4318.

4) Proctor compaction test of the quarry dust and sandy soil

The proctor compaction tests were conducted according to the BS 1377 standard for following mixtures of quarry dust and sandy soils as given in Table 1.

Table 1 Mixtures of quarry dust and sandy soils

Mixture No	Percentages of Quarry Dust (%)	Sandy soil (%)
1	0	100
2	10	90
3	20	80
4	30	70
5	40	60
6	50	50

RESULTS AND DISCUSSION

Below shows the results of the tests conducted on sandy soil, quarry dust and their respective mixtures.

1. Particle size distribution

Fig. 1 demonstrates the particle size distributions of the sandy soil and quarry dust. In the soil, fine content is calculated as less than 5% while rest is determined as sand. Only around 2% soil is consist of coarse sand (>2mm). Around 50% of the soil consist of medium sand (0.425mm-2mm) while the fine sand (0.075mm -0.425mm) content is observed to be around 40%. Also Uniformity Coefficient (Cu) and Coefficient of Curvature (Cc) values of sandy soil are calculated as 5 and 1.12 respectively. Therefore the soil can be considered as well graded sand. For quarry dust, Cu & Cc values were calculated as 20 and 1.08 respectively. It is clear that quarry dust exhibit more well graded qualities compared to the sand soil, as indicated by the Cu value.

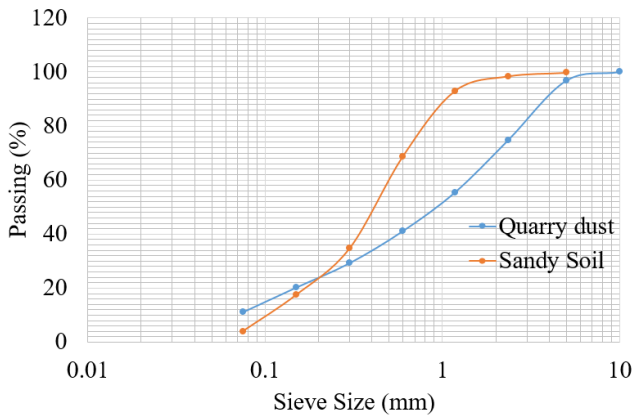


Figure 1 Particle size distribution of sandy soil & quarry dust

2. Specific gravity

The results of the specific gravity tests shown in Table 2 . It is evident that average specific gravity (at 20°C) of quarry dust is significantly higher than that of the sandy soil

Table 2 average specific gravity at 20 °C

Test	Specific gravity at 22 ^o C
Sandy Soil	2.404
Quarry dust	2.678

2. Liquid Limit & plastic limit

Liquid limit of quarry dust was determined as 13% while for sandy soil, it was determined as 28.5%. No plastic limit reading was possible for both sandy soil and quarry dust.

3. Proctor compaction

Proctor compaction results of the sandy soil in fig. 2. The maximum dry density is shown to be less than 1.5g/cm³ while the optimum water content is observed at a relatively higher value of 21 %. Fig. 3 details the Proctor compaction results of all mixtures of quarry dust and sandy soils. The typical maximum dry density - optimum moisture content relationship is being observed more or less in all the mixtures.

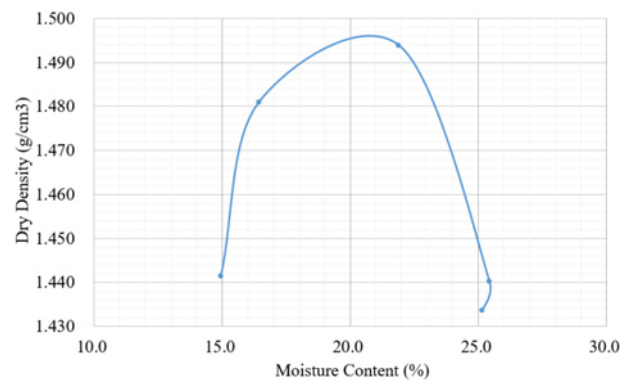


Figure 2 Proctor compaction results for the sandy soil

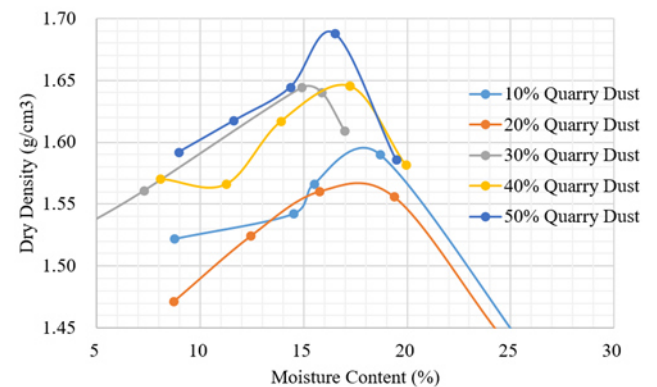


Figure 3 Proctor compaction results after mixing paddy soil with quarry dust.

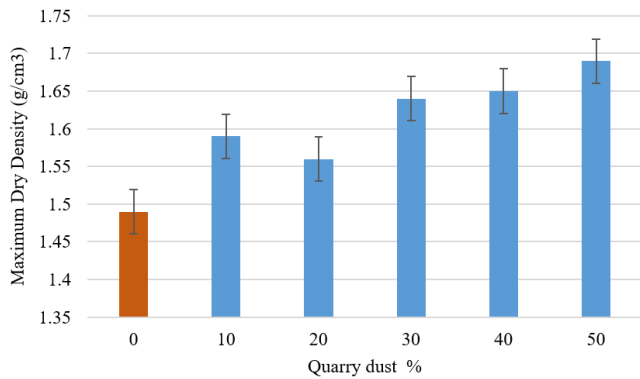


Figure 4 Maximum dry density vs quarry dust percentage

Quarry dust consists of higher specific gravity (2.678) compared to the sandy soil (2.404). It is evident that addition of quarry dust should increase the overall density of the mix due to this difference in specific gravities. As shown in the fig. 4 the maximum dry density increased in each 10 % increment of quarry dusts used in the mix except for the 20% quarry dust mix. Even though the 20% quarry dust mix slightly deviates from the increasing trend, the achieved maximum dry density value is higher than that of sandy soil without quarry dust. Also, the error bar (standard error) comparison indicates that all the quarry dust-sandy soil mixtures achieved a significant increase in maximum dry density compared to sandy soil without quarry dust. In the other hand, it is fair to assume that the disparity between particle size distribution curves also may have contributed to this increment of maximum dry density. As we can observe in fig 1 and from the values obtained for C_c and C_u , it is clear that quarry dust exhibits relatively high well graded qualities compared to the sandy soil. When higher percentage of quarry dust get added it may increase well graded qualities of the soil and hence improve the ability to compact. Also, the other noticeable difference is that quarry dust contains significant amount (30%) of coarse particles ($>2\text{mm}$) compared to the sandy soil (2%). As a result of that the soil – quarry dust mix offers a higher range of particle size distribution and along with its well gadded characteristics, a higher degree of compaction can be expected.

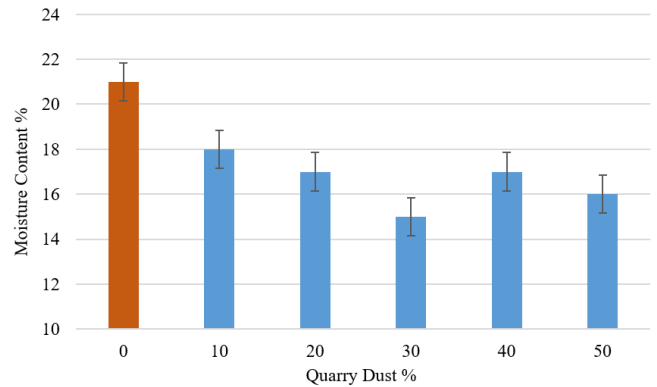


Figure 5 Optimum moisture content vs quarry dust percentage

As shown in fig. 5, the optimum moisture content tends to decrease with the addition of quarry dust to a certain extent, where the least value is achieved at 30% quarry dust mix. However, this tendency is shown to decline as the quarry dust % increased beyond 30 % and it is obvious that the mix required more water to reach the maximum dry density. The error bar comparison indicates that all the quarry dust- sandy soil mixtures achieved a significant decrease in optimum moisture content compared to sandy soil without quarry dust. The annular shape of quarry dust makes it difficult for the particles to slip past each other when it is subjected to a given compaction effort. Therefore, it may require more water to lubricate the relative movement among particles and hence explain the requirement of additional water content with the increment of quarry dust. Apart from that it can also be observed that the minimum value obtained for 30 % mixture is significant as suggested by the error bar comparison. Therefore this particular mixture can be identified as the one that requires least amount of water to achieve its maximum dry density.

CONCLUSION

The results indicated that maximum dry density continues to increase with the addition of quarry dust. It was also found that optimum water content reduces up to the addition of 30% quarry dust but starts to deviate from that trend as more quarry dust being added. In overall, it is evident that compaction characteristics can be improved using quarry dust which increases the suitability of the soil for construction purposes. However adding more than 50% of quarry dust can be impractical as well as meaningless. Since quarry dust percentages of 30%,40% shows significant improvements those percentages can be set as upper bounds of practical use.

One limitation of this study is that the sandy soil was collected from a specific location. Therefore, it is important to notice that the soil used in the study may be less representative of general conditions of local paddy fields.

REFERENCES

1. Gajo, A., Piffer, L. and De Polo, F., 2000. Analysis of certain factors affecting the unstable behaviour of saturated loose sand. *Mechanics of Cohesive-frictional Materials: An International Journal on Experiments, Modelling and Computation of Materials and Structures*, 5(3), pp.215-237.
2. Koustuvee, K., Sridharan, A., Chinmoy, K., Rahul, D. and Malaya, C., 2013. A Study on the influence of particle characteristics on shear strength behavior of quarry dust. In *Proceedings of Indian Geotechnical Conference*, pp. 1-5.
3. Nwaiwu, C., Mshelia, S. and Durkwa, J., 2012. Compactive effort influence on properties of quarry dust-black cotton soil mixtures. *International Journal of Geotechnical Engineering*, 6(1), pp.91-101.
4. Priyankara, N.H., Wijesooriya, R.M.S.D., Jayasinghe, S.N., Wickramasinghe, W.R.M.B.E. and Yapa, S.T.A.J., 2009. Suitability of quarry dust in geotechnical applications to improve engineering properties. *Engineer: Journal of the Institution of Engineers, Sri Lanka*, 42(3).
5. Soosan, T.G., Sridharan, A., Jose, B.T. and Abraham, B.M., 2005. Utilization of quarry dust to improve the geotechnical properties of soils in highway construction. *Geotechnical Testing Journal*, 28(4), pp.391-400.
6. Sridharan, A., Soosan, T.G., Jose, B.T. and Abraham, B.M., 2006. Shear strength studies on soil-quarry dust mixtures. *Geotechnical & Geological Engineering*, 24, pp.1163-1179.

Original Article

Evaluation of Knowledge, Attitudes and Practices on Facial Skincare Routines and Cosmetic Products in Undergraduates of Universities and Higher Educational Institutes in Western Province, Sri Lanka

Jayathilake H.P.U.V.¹, Nikathenna H.M.L.S¹, Dharmapriya H.A.T¹, Wanniarachchi P.K¹, Handugala H.M.D¹, Amarasinghe S.S¹, Wanasinghe W.A.D.M¹, Ratnayake W.M.K.M¹

¹*Department of Cosmetic Science, Faculty of Health Sciences, CINEC Campus, Sri Lanka
kalpani.ratnayake@cinec.edu*

ABSTRACT

Maintaining the skin's structural and functional integrity is largely dependent on proper skincare. Numerous dermatological problems can be caused by insufficient skincare techniques and inadequate information. For this reason, following an appropriate skincare routine is essential to preserving the health of the skin. The purpose of this study was to evaluate undergraduates in universities and other higher education institutions in the Western province of Sri Lanka regarding their knowledge, attitudes and practices regarding facial skincare practices. A structured questionnaire (N=255) was used in descriptive cross-sectional research of undergraduates in the Western province who were between the ages of 18 and 30. Ethical clearance was obtained from the Ethics Review Committee at CINEC Campus. There were 21.18% male participants and 78.82% female participants in the study, which included 145 undergraduates from state universities and 110 from non-state Higher Educational Institutes. The results showed that while buying face skincare products, students consider into thought several aspects, such as brand (66.27%), price (69.02%), ingredients (74.50%), expiration date (65.10%), skincare benefits (73.72%), smell (31.37%), and container (25.10%). Merely 9.42% of respondents preferred synthetic components in cosmetic products, compared to a sizable majority (90.58%) who preferred natural ones. When it came to applying sunscreen, 33.33% did it five minutes before exposure to sunlight, and 56.08% did it thirty minutes beforehand. While 34.11% of respondents knew that an optimal sunscreen in Sri Lanka should have a UV protection

factor of between 30 and 50, 43.92% did not. The primary reasons given for using skincare products were to enhance appearance and texture (62.74%), prevent sunburns (54.90%), and improve skin health (76.08%). Notably, the most often used skincare items were moisturizer (48.23%) and face cleanser (82.53%). Furthermore, (67.06%) of undergraduate students chose skincare products for their faces according to their skin type; (27.45%) did it infrequently, and (5.10%) never gave it any thought. The study revealed that some undergraduates lack accurate awareness about skincare routines, indicating a need for additional knowledge in this area.

Index Terms – Cosmetic, Facial, Skincare

INTRODUCTION

Skin is the largest organ of the body, which aids in maintaining the integrity of the host while also allowing the host to connect with the outside world [1]. It serves as a barrier between the internal and the external environment, providing many functions necessary for human survival such as protection from dehydration and excessive water influx, electrolyte homeostasis maintenance, thermoregulation, tactile sensation, antimicrobial defense, and protection from environmental toxins, trauma, and ultraviolet (UV) radiation [2]. Accurate knowledge, good attitudes and healthy practices will surely have a positive effect on the consumer's skin condition boosting self-confidence. Hence, it is important to take care of the skin regularly in a proper manner.

The skin's three primary layers are the subcutaneous tissues, epidermis and dermis. The epidermis generally consists non-viable part which is made by the stratum corneum and the viable part which contains the remaining layers of the epidermis. Apocrine glands, sweat ducts, and hair follicles are a few other appendages that presents in human skin [3].

Facial skin can be considered as the most concerned skin in the body by individuals. Maintaining a proper facial skin care routine may aid the physical, mental and social well-being of an individual followed by society as well. Despite a skincare routine can begin at any age or period, dermatologists and cosmetologists agree that skincare and facial routines should begin as early as teens.

The term "skin care" refers to procedures that help keep the skin in its most comfortable and sanitary form. These procedures involve cleansing one's skin, using skin care products, and photoprotection. It is a common process that is conducted daily in various settings, depending on whether the skin is too dry or too wet. Cosmetic products, such as skincare ointments, lotions, and powders, are often manufactured or natural substances, or mixes of both, that contain a wide spectrum of chemicals to which we are constantly exposed [4]. Sunscreen usage is a modifiable behavior that can help lower the risk of skin cancer, avoid sunburns, slowing photo ageing, and treat photosensitive issues.

The knowledge, attitudes, and practices around skincare have been the subject of several studies carried out in various countries. According to a study done in Thailand in 2022 by Nitiyaron and coworkers, gender and age group have a significant impact on teenagers' skin care behaviors and knowledge [5]. According to their study, only a small percentage of teenagers routinely use sunscreen, despite knowing that it may minimize the effects of sunlight. They have further elucidated that the main sources of skin care information that teenagers looked up were television and radio, print media, and individuals. According to the Indonesian study conducted by Kawa, Rahmadiani, and Kumar in 2013, they concluded that consumer buying behaviour toward

cosmetics heavily depends on the brand name, packaging, location, and store environment [6].

There are various studies based on the skincare routine of university students. Attitudes and behaviour of female medical students related to facial skin care routine were assessed by [1], conducting a cross-sectional study from Feb 2016 to May 2016. The information collected through a self-administered questionnaire indicated that 76.7% of the participants do not follow regular skincare routines, 66% do not use sunblock and 29% stated that they have suffered from sunburn. Lotions and moisturizers were the most commonly used products (74%). On the other hand, the use of makeup was higher than the use of skin care facials [1]. Also, Upadhyay and coworkers evaluated the awareness and practices regarding skin care among 300 medical students from Western India by conducting a cross-sectional study. The majority of participants were female (67%) and the rest (33%) were males. The participants were aged from 17 to 23 years. (31%) believed that the face should be washed twice a day. Students were also aware of the benefits of removing make-up before sleep (51%). However, 70.3% of the participants were unaware of the sunscreen appropriate for them to use. But 15.7% were aware that it should be 30-50 SPF [2].

However, studies are scarce regarding skin care awareness and practices among undergraduate students in Sri Lanka. Hence, this study was carried out to evaluate the knowledge, attitudes and practices regarding facial skin care routine and cosmetic products among undergraduate students in Western Province, Sri Lanka.

RESEARCH METHODOLOGY

The Research study was a descriptive cross-sectional study. The study population was undergraduates in state and non-state universities and higher educational institutes in Western Province, Sri Lanka. The 7 state universities and 12 non-state higher educational institutes which provide bachelor degrees in the Western province were selected for the study. The sample size was calculated by using a standard formula ($n = \frac{Z^2 \times p(1-p)}{d^2}$ where n = Sample size, Z = standard normal deviation for the chosen confidence level. Z will be 1.96 in confidence level 95%, p =

expected proportion of the subjects with the characteristics and $d =$ margin of error). The sample size in this preliminary study was 255 participants. The data set used in the study was collected by a survey administered to state and non-state undergraduates at universities and higher educational institutes in the Western province of Sri Lanka, who have given their consent to participate in the study and who are free of any physical or mental disabilities that may hinder them from responding to the questionnaire. Participants who did not wish to provide data for the research and those who did not comply with the relevant admission recommendation were excluded.

The Survey contains 30 questions selected to assess the knowledge, attitude and practices toward using facial skincare routine. Survey data were collected from a convenience sample, using a self-administered questionnaire survey. Structured questionnaires with close-ended questions were used in the current study to gather information about respondents' knowledge, attitudes and practices regarding facial skincare routine. A validated questionnaire was prepared as a Google form in three languages i.e. Sinhala, English and Tamil, and distributed through social media platforms openly inviting undergraduates from state and non-state universities in Western province. Those who had consent to participate in the study filled out the consent form and the questionnaire.

Ethical clearance for this study was obtained from the Ethics Review Committee of the CINEC Campus, Malabe, Sri Lanka (ERC No: ERC/CINEC/2022/029).

The questionnaire consisted of four categories. i.e., Socio-demographic characteristics, Knowledge of participants towards facial skincare routines, Attitudes of participants towards facial skincare routines and Practices of participants towards facial skincare routines

The data was analysed using SPSS version 26. Descriptive statistics, mean \pm SD, frequencies, and percentages were computed. Normality is assessed using graphical representations and Kolmogorov statistics. The continuous variables were compared

using ANOVA and categorical variables using Chi-square statistics. $p < 0.05$ was significant.

RESULTS

The knowledge, attitudes, and practices of undergraduates on facial skin care of undergraduates of universities and higher educational institutes in the Western province, of Sri Lanka were evaluated by analyzing data gathered by an online questionnaire.

DEMOGRAPHIC DATA

Among the participants, the majority were female (78.82%) and belonged to the age category of 22-24 years (43.52%) (Table 1). Further as shown in Table 1, the majority of undergraduates are from state universities (56.86%) and the majority have a health science background (42.35%).

Table 1: Socio-demographic characteristics of the undergraduates of universities and higher educational institutes in the Western province (N= 255)

Variable	(%)	
Gender		
Male	54	21.17
Female	201	78.82
Age		
18-21 Years	22	8.62
22-24 Years	111	43.53
25-27 Years	87	34.12
28-30 Years	35	13.72
University/ Campus/ Higher Educational Institute Category		
State	145	56.86
Non-state	110	43.13
Subject stream of degree programme		
Medicine	4	1.56
Health Science	108	42.35
Bioscience	44	17.25
Animal Science	3	1.17
Nutrition	4	1.56
Engineering	19	7.45
Biotechnology	9	3.52
Engineering technology	2	0.78
Art	4	1.56
Commerce	14	5.49
Psychology	7	2.74
Information technology	15	5.88
Other	23	9.01
Engaging in self earning money		
Yes	110	43.13
No	145	56.86

In addition to the Socio-demographic characters shown in Table 1, the study has shown that the home town of the majority of participants (N=63) is Gampaha (Figure 1).

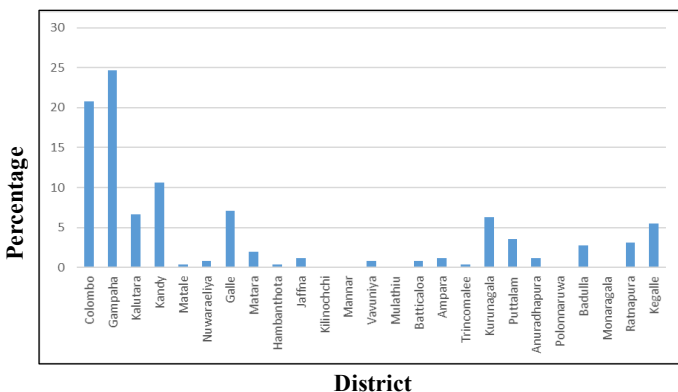


Figure 1: Home town of participants (N= 255)

Knowledge

Out of 255 undergraduate participants, the majority (N=209; 82%) know how to identify different types of skin (Figure 2).

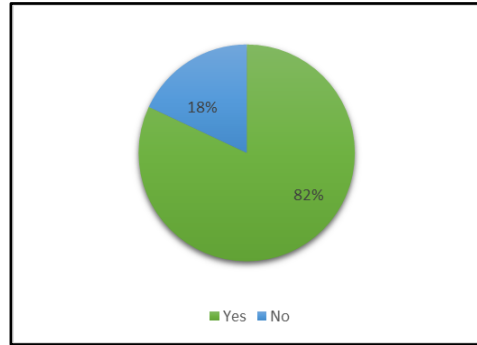


Figure 2: Ability to identify different types of skin among the undergraduates of universities and higher educational institutes in the Western province (N= 255)

All participants are aware of their skin type and the majority of participants reported that they have oily and combination skins (Table 2)

Table 2: Skin types of the undergraduates of universities and higher educational institutes in the Western province (N=

Skin type	Number	(%)
Dry Skin	34	13.33
Oily Skin	79	30.98
Sensitive Skin	28	10.98
Combination Skin	78	30.59
Normal Skin	36	14.11

255)

The study also evaluated the knowledge on sunscreen products and the questionnaire concerned about the knowledge on sun protecting factor (SPF) of sunscreen cream ideal for Sri Lanka (Table 3). The results showed that the majority (43.92%) of the participants are not aware of the SPF value of sunscreen products suitable for Sri Lanka.

Table 3: Response to the question “What should be the sun protection factor of an ideal sunscreen in Sri Lanka” by undergraduates of universities and higher educational institutes in the Western province (N= 255)

Response	Number	(%)
Below SPF 30	20	7.84
SPF 30-50	87	34.12
More than SPF 50	36	14.12
Don't know	112	43.92

In addition to that, the knowledge of the application of sunscreen products was also evaluated and the majority (56.08%) mentioned that 30 minutes before going outside is the best time to apply sunscreen (Table 4).

Table 4: Response to the question “When do you use sunscreen” by undergraduates of universities and higher educational institutes in the Western province (N= 255)

Response	Number	(%)
5 min before going outside	85	33.33
5 min after going outside	3	1.18
30 min before going outside	143	56.08
30 min after going outside	6	2.35

Attitudes

Among the participants, only a low percentage (20.39%) was strongly concerned about their facial skin routine (Figure 3).

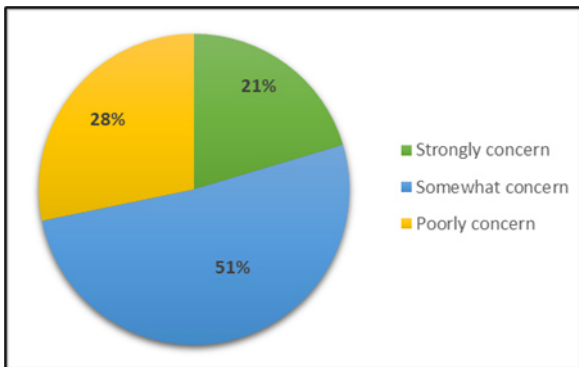


Figure 3: Percentage of concern about facial skincare routine among the undergraduates of universities and higher educational institutes in the Western province (N= 255)

Further, the study has evaluated the preference for natural and synthetic skincare routines among the undergraduates of universities and higher educational institutes in the Western province. As shown in Figure 4, the majority (n= 231) mentioned that they prefer natural skincare products.

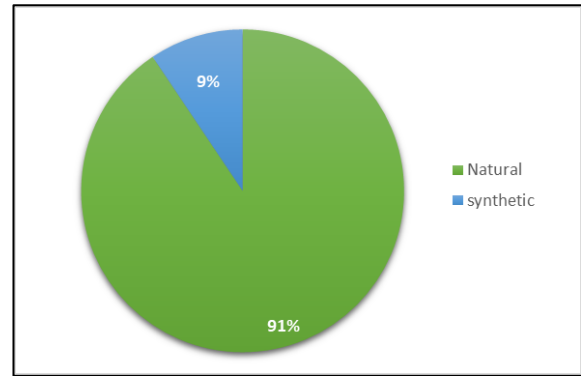


Figure 4: Percentage of preference for sources of skincare products among the undergraduates of universities and higher educational institutes in the Western province (N= 255)

In addition, the research has evaluated the reason for using skincare products among the undergraduates of universities and higher educational institutes in Western provinces. The questionnaire allowed us to select more than one option for the reason of using skincare products. As shown in Figure 5, the majority (76.08%) agreed with the statement that they use facial skincare products to improve the healthiness of skin. Only a few of the participants (1.18%) mentioned that they are using facial skincare products as a trend.

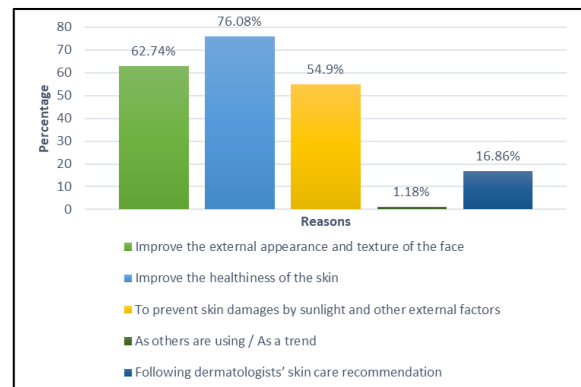


Figure 5: Percentage of reasons for using skin care products among the undergraduates of universities and higher educational institutes in Western province (N= 255)

However, the results showed that the majority of participants prefer medicinal drugs over cosmetic products when they have skin issues in their face (Figure 6).

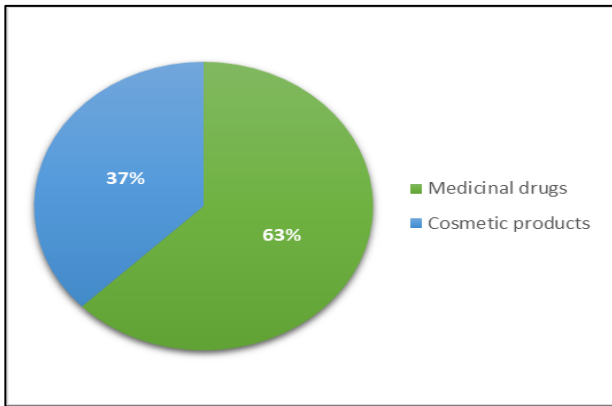


Figure 6: Percentage of preference for sources when having issues on skin, among the undergraduates of universities and higher educational institutes in Western province (N= 255).

In addition, the study evaluated the selection of facial skincare products according to the skin types and the majority mentioned that they selected those accordingly (Figure 7).

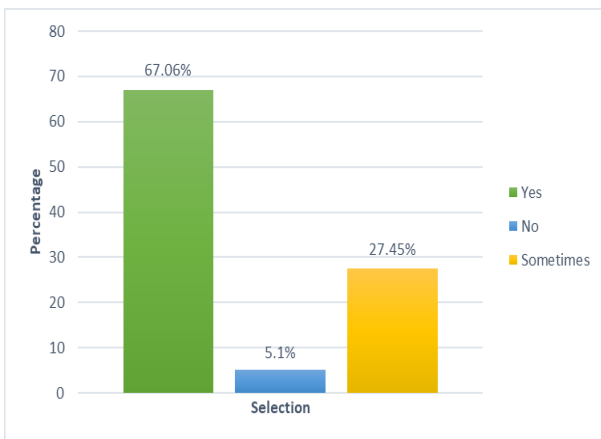


Figure 7: Selection of facial skincare products according to the skin types by the undergraduates of universities and higher educational institutes in the Western province (N= 255)

Practices

The research has also evaluated the cosmetic products generally used by undergraduates in universities and higher educational institutes in Western provinces. The questionnaire allowed to selection of more than one cosmetic product for each individual. Studies showed that participants are using face wash, face cleansers, scrubs, facial packs, facial serum, facial toner, under-eye serum, sunscreen, moisturizer, night cream, day cream

and anti-ageing cream (Figure 8). Among the product list majority (82.53%) mentioned that they used facewash. However, only a minority of the participants (2.35%) is used under eye serum

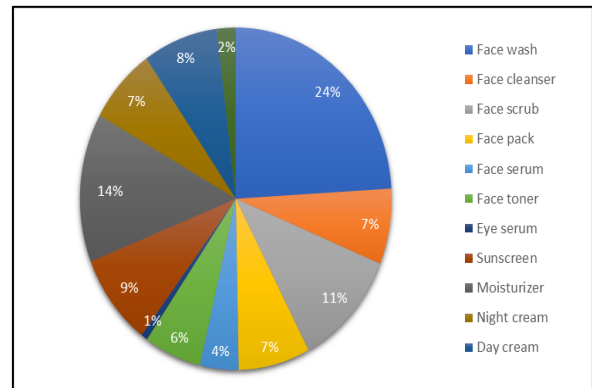


Figure 8: Commonly used facial skincare cosmetic products the undergraduates of universities and higher educational institutes in the Western province (N= 255)

Further, among the factors evaluated through the questionnaire regarding the purchasing facial skincare products, skin types (75.7%), ingredients (74.5%) and skincare benefits (73.7%) were identified as the factors considered by the majority when they purchasing a facial skin care product (Figure 9). The nature of the container was identified as the factor which pay the least attention (25%) when purchasing a facial skincare product.

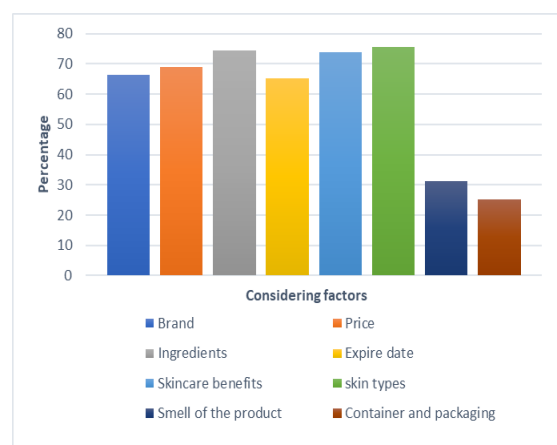


Figure 9: Factors considered when purchasing skincare products in the undergraduates of universities and higher educational institutes in Western province (N= 255)

Also, the research experiment evaluated the source of information about facial skincare products and the questionnaire allowed to mark the first, second and third choice of the participants according to priority (Figure 10). According to the responses, the majority mentioned they are giving priority to getting information about facial skincare products, by medical practitioners as the first choice (55.68%). The majority mentioned product labels (34.51%) and by recommendation (34.90%) as the second choice and mass media (36.86%) and social media (35.68%) as the third choice in the priority list of getting information about facial skincare products.

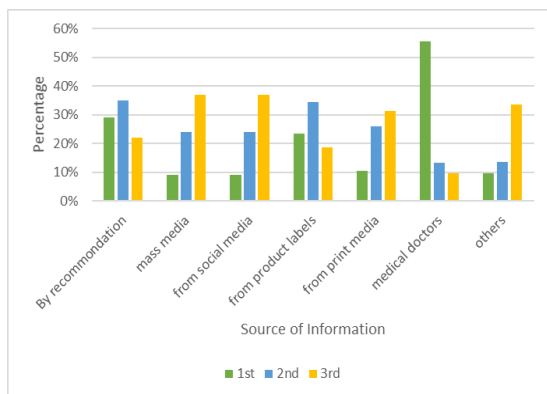


Figure 10: source of information about facial skincare products by the undergraduates of universities and higher educational institutes in the Western province (N= 255)

Further, the study evaluated the continuous use of the same facial skin care product long term (Figure 11) and the majority (64.31%) mentioned that they are continuously using the same product.

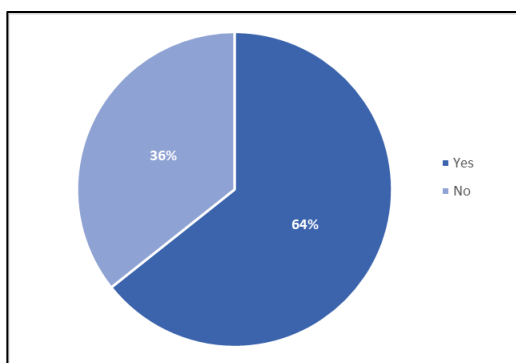


Figure 11: Percentage of continuous use of the same facial skin care product long term by the undergraduates of universities and higher educational institutes in the Western province (N= 255)

However, 71.76% of participants mentioned that sometimes they change the brand of the facial care product (Figure 12).

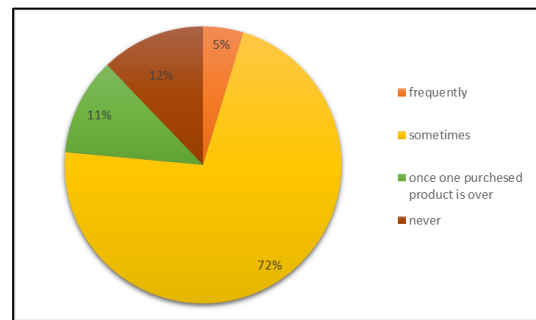


Figure 12: Percentage of frequency of change of brands of facial care products by the undergraduates of universities and higher educational institutes in the Western province (N= 255)

DISCUSSION

As the skin is constantly losing skin cells throughout the day, it's critical to maintain healthy, radiant skin. However, as the skin is one of the major components involved in the outside beauty of individuals, there is a huge attention on maintaining the appearance of the skin, especially in the youth generation. Hence, this study was focused on evaluating knowledge, attitudes and practices on skincare routines and cosmetic products among undergraduates who represent part of the youth generation in the country. Skincare is a wide range of practices that support maintaining the integrity of the skin, improving its appearance, and treating skin disorders. These may consist of proper diet, avoiding excessive sun exposure, and using appropriate emollients. Additionally, there are several varieties of skin, including combination, oily, dry, and normal skin. Depending on the type of skin, there are differences in recommended products and skincare regimens. Hence, the study focused on evaluating the knowledge about the skin types and their identification. Among the participants 82 % were able to identify their skin type and the remaining 18 % were not able to identify their skin type on their own. The most common skin type of the participants was oily skin (30.98%), then combination skin (30.58%), followed by, normal skin (14.11%), dry skin (13.33%) and sensitive skin (10.98%). Consonance with the research studies done overseas, it has been found that the

most common skin type varies with the population. Considering the Asian region commonly having combination skin and oily skin [5],[7]. The research conducted as knowledge, attitudes and practices regarding skin care in Saudi Arabia concluded that the most common skin type of their respondents was combination skin (52.1%), then oily skin (24.8%), followed by dry skin (12.4 %). In that research, there were not any participants who identified their skin as normal skin and 10.7% of participants did not know to identify their skin type [4]. Furthermore, considering another research conducted in Thailand most of the participants identified their skin as oily skin (39.0%), followed by normal skin 37.5% and dry skin 9.2%. That research also mentioned the participants (14.2%) who do not know how to identify their skin type [5].

By evaluating the factors which are considered when purchasing a facial skincare product found out that, participants were considering a combination of factors when purchasing a product. Among the factors most priority factor was skin type 75.68%, then ingredients included in the product 74.50% could be taken as important. The least considerate factor was containers which contain the product (25.09%). There was research conducted in Andhra Pradesh, India as A study on knowledge, attitude and practice of using cosmetics among university students, that concluded that participants mostly considered the features of the product (53.0%), then packaging and appearance (24%). Followed by a price of 18.3%. The advertisements were taken as the least considerate factor (4.7%) [7].

While sun exposure is essential for the synthesis of vitamin D, prolonged exposure to UV rays may promote premature ageing, trigger the production of reactive oxygen species, cause skin cancer, and degrade extracellular matrix components such as collagen type I, fibronectin, elastin, and proteoglycans [8]. Applying sunscreen to exposed skin areas may aid in shielding the skin from damaging UV radiation. Hence, nowadays there is a wide popularity of sunscreen cosmetic products due to extra health advantages apart from beautification [9]. Because of the importance of sunscreen products in a skincare routine, this study evaluated the knowledge of sunscreen also. The

ratio of the minimum UV energy needed to cause minimal erythema on sunscreen-protected skin to the UV energy needed to cause the same erythema on unprotected skin is known as the sun protection factor, or SPF [10]. As Sri Lanka is a country near the equator, it has a high UV index and it is recommended SPF of 30+ sunscreen is suitable for Sri Lanka [11]. However, the majority of the participants (44%) mentioned that they do not know the correct sun protection factor which is ideal for weather in Sri Lanka. Only 14.11% of participants mentioned the appropriate SPF value relevant to Sri Lanka.

Considering the research conducted in Thailand, the highest number of participants were not knowing the correct sun protection factor (31.9%) [5]. Considering the research conducted in Saudi Arabia, most of the participants marked their appropriate sun protection factor as 18 to below 30 (54.8%) [4].

By U.S. FDA standards, sunscreen should be administered before 30 minutes to maximize its benefits. After that, the skin has time to absorb the substance. It is crucial to reapply sunscreen after 30 minutes to ensure that the skin has an appropriate layer of protection. Interestingly, the majority of participants (56.07%) were aware of the appropriate time for application of sunscreen.

By evaluating the attitudes of the participants identified that most of the participants prefer to use natural skin care products (90.59%). Considering the research conducted in India that factor can be taken as a confirmation due to their participants also mostly preferred to use ayurvedic skin care products (45.3%), then cosmetic products contain medicinal value (27.0%), followed by organic cosmetics (24.0%) and chemical containing cosmetic products (3.7%) [7].

Regarding the evaluation of the reason for using facial skin care products, participants tend to mark a combination of responses. Among them, they mostly preferred skin care products to improve the healthiness of skin 76.0%. When compared to the research conducted in India, they mostly use cosmetics as protection for the skin (40.0%) [7]. The research conducted in Thailand mentioned

that they mostly use skin care products to cure acne symptoms 65.8% [5].

Regarding the practices, most of the participants (67.06%) are selecting the skin care products according to their skin type rather than considering other factors. According to the results of usage of bleaching products least count of participants used them intentionally or unintentionally (17%). Considering the research conducted in other countries they were more into using of bleaching and skin-lightening agents. The research conducted in Pakistan stated that 59% of participants tended to use skin-lightening agents [12]. The research conducted in Malaysia concluded that 60% of participants tend to use skin-lightening agents [13].

CONCLUSION

The current study investigated the knowledge, attitudes, and practices on facial skin care routines in undergraduates of universities and higher educational institutes in the Western province, of Sri Lanka, with the ultimate aim of uplifting consumer safety and improving the awareness of facial skincare routines. The results conclude that the majority of participants lacked the necessary understanding regarding facial skincare routines and SPF value. The analyzed data clearly showed that more than 90% of participants preferred natural products rather than synthetic products. Based on the survey results, the majority of participants were purchasing skin care products according to their skin type. In conclusion, the knowledge, attitude, and practices of facial skincare behaviour in undergraduates of universities and higher educational institutes in the Western Province, Sri Lanka was at an average lower level than expected.

Improving the knowledge, attitudes and practices on facial skincare is a crucial factor. Therefore, it is important to educate and provide sufficient knowledge and practices to the public. Furthermore, it is recommended to carry out a research survey to analyse the knowledge, attitudes and practices among other age groups and other educational level participants.

DECLARATIONS

A. Study Limitation

This study was limited to 255 undergraduates in universities and higher educational institutes in Western Province, Sri Lanka. Moreover, self-reported answers were vulnerable to biases and errors in reporting, which might lead to an overabundance or underabundance of information because of misinterpreted questions.

B. Acknowledgements

The authors would like to thank all participants who had volunteered for the study.

C. Funding source if any

None.

D. Conflict of Interests

No conflict of interest exists in this publication.

E. Ethical Approval

This study was reviewed and approved by the Ethics Review Committee of CINEC Campus, Malabe, Sri Lanka.

F. Informed Consent

Informed consent which was approved by the Ethics Review Committee of CINEC Campus, Malabe, Sri Lanka was shared with the participants before the questionnaire.

REFERENCES

1. Alqulaity, W., Sheitt, A., Bakheet, D., Tallab, M., Zimmo, S. 2017. Skin care routine among female medical students at king Abdulaziz university hospital (Kauh), Jeddah, Saudi Arabia. *International Journal of Advanced Research*, 5(2):400–5.
2. Upadhyay, H., Parikh, C., Nair, P. 2021. Awareness and Practices about Skin care among medical students: A cross-sectional study, *Journal of Clinical and Diagnostic Research*, 15(3); DOI: 10.7860/JCDR/2021/47019.14740

3. Walters, K. A., Roberts, M. S. 2002. The structure and function of skin, Dermatological and transdermal formulations, 10.1201/9780824743239.ch 1
4. Alsharif, S. H., Alqahtani, S. H., Alqarehi, R. M., Alsayed, M. A., Alzahrani, A. S., Alharthi, A. M., Alruwaili, A. S., Alfada, M. A. 2022. Knowledge, attitudes, and practices regarding skin care in Saudi Arabia: A cross-sectional, survey-based study, *Cureus*, 14(2): doi: <https://doi.org/10.7759/cureus.32490>
5. Nitiyarom, R., Banomyong, N., Wisuthsarewong, W. 2022. Knowledge about, attitude toward, and practices in skin care among Thai adolescents, *Journal of Cosmetic Dermatology*, 21(4):1539-1546 doi:10.1111/jocd.14309.
6. Kawa, L. W., Rahmadiani, S. F., Kumar, S. 2013. Factors affecting consumer decision-making: a survey of young-adults on imported cosmetics in Jabodetabek, Indonesia, *SIJ Transactions on Industrial, Financial and Business Management*. 1(5):175-80.
7. Manjula, K., Vani, A., Parvathi, M. S., Srujana, U. M. 2022. A study on knowledge, attitude and practice of using cosmetics among the university students, *International Journal of Health Sciences*, 5083–100. <https://doi.org/10.53730/ijhs.v6nS8.13369>
8. Cadet, J., Douki, T., Pouget, J. P., Ravanat, J. L., Sauvaigo, S. 2001. Effects of UV and visible radiations on cellular DNA, *Current Problems in Dermatology*. 29:62–73. doi: 10.1159/000060654.
9. Shanbhag, S., Nayak, A., Narayan, R., Nayak, U. Y. 2019. Anti-aging and sunscreens: Paradigm shift in cosmetics, *Advanced Pharmaceutical Bulletin*. ((3):348–59. doi: 10.15171/apb.2019.042
10. Diffey, B. 2000. Has the sun protection factor had its day?, *British Medical Journal*. 320(7228):176–177. doi: 10.1136/bmj.320.7228.176
11. Napagoda, M. T., Malkanthi, B. M. A. S., Abayawardana, S. A. K., Qader, M. M., Jayasinghe, L. 2016. Photoprotective potential in some medicinal plants used to treat skin diseases in Sri Lanka, *BMC Complementary and Alternative Medicine*, 24;16(1): 479 doi: 10.1186/s12906-016-1455-8.
12. Askari, S. H., Sajid, A., Faran, Z., Sarwar, S. Z. 2017. Skin-lightening practice among women living in Lahore: Prevalence, determinants, and user's awareness, *Skin-Lightening Practice among Women Living in Lahore*. 2017; <https://cgr.umt.edu.pk/icobm2013/papers/Papers/IC3-Dec-2012-066.pdf>
13. Kouotou, E. A., Nansseu, J. R. N., Adegbidi, H., Mebara, T. C. J. Z., Ndam, E. C. N. 2017. Skin whitening among Cameroonian female university students: Knowledge, attitudes, practices and motivations, *BMC Women's Health*. 17:33 <https://bmcwomenshealth.biomedcentral.com/articles/10.1186/s12905-017-0385-z>

Original Article

Factors Affecting the Supplier's Quality of the Perishables Supply Chain; Special Reference to the Hotel Industry in Sri Lanka

Habaragamuwa D.I¹, De Silva C.D²

¹Department of Logistics and Transportation, Faculty of Management and Social Science, CINEC Campus Malabe Sri Lanka

²Department of Management and Business Studies, Faculty of Management and Social Science, CINEC Campus Malabe Sri Lanka

dilhanidesilva@cinec.edu

ABSTRACT

Food is the main factor that anyone who measures the quality on a hotel or a restaurant. If there is good quality food, consumer will never forget to revisit that restaurant. If they are unable to maintain the food quality of perishables there can be many issues for hoteliers that directly affect the business. In this context, suppliers' quality, of the perishables supply chain plays vital role in the hospitality industry as it engages with many aspects, procurement, packing, transportation, storage, temperature, and maintenance. However, these challenges affect the final quality of perishable food items therefore, identifying these factors is crucial for hoteliers to develop strategies to mitigate them. Therefore, the current study investigates the most critical factors that affect the supplier quality of the perishables supply chain and finds the impact of variables on the quality of the perishable supply chain in the hospitality industry, in Sri Lanka. In this study, an online questionnaire was distributed among the people who work in the procurement section and the hotel chefs in the 3-star to 5-star hotels, in Negombo and Colombo. The convenience sampling method was used with 384 respondents, but the survey was concluded with 200 responses because of these data collected from managerial and executive level employees from selected areas in Gampaha district. The reports of the statistical outputs of the SPSS analysis, including reliability analysis, demographic factor analysis, cross-tabulation analysis, descriptive analysis, correlation analysis, and regression analysis, are included in the study. However, the outcome shows high internal consistency in the reliability test, positive ratings for temperature, storage method, packaging method, lead time, and transport method and there

was a significant positive correlation between these variables and the quality of the perishable supply chain showing the positive impact. Further research suggests examining the impact of each perishable factor in depth by exploring the relationship between quality and food wastage.

Index Terms- Perishable Supply Chain, Food Quality, Supplier's Quality

INTRODUCTION

The Sri Lankan hotel industry is a developing industry with remarkable natural tourism resources, modern trends, and an authentic food culture. It is a well-known holiday destination, growing in the world with many hotel chains growing across the island. As per the Sri Lanka Tourism Board statistics, tourism makes a significant contribution to the country's GDP. Even after the Easter Sunday attack, the tourism sector's foreign exchange earnings are still contributing to the economy. In this nature, drawing attention to the hotel industry is vital for every hotel owner because the basic measurement that any guest uses to measure the standard of the hotel is the food that they are served. (Saurav Negi, 2016) Therefore, effective supply chain management for perishable food such as meat, eggs, fish, dairy products, vegetables, and fruits is crucial for them, as it networks the company and suppliers to produce and distribute a specific product to the final buyer. Therefore, the challenges may lead to spoilage, safety risks, and quality deterioration (Anon., 2021), which creates serious circumstances not only for hoteliers but also for suppliers and consumers. (Anna Brzozowska, 2016). Global perishable food waste is high during the upper stream of the supply chain process. So, the hotels always try to reduce their waste and save the cost they spend on perishables in their operations. In this way, the quality of perishable foods depends on the type of supplier selected by the

company, and food waste is significant in the supplier's process. However, this paper focuses on finding out the most influencing suppliers' quality factors of the perishable supply chain in the hotel industry and its impact on suppliers' quality and the perishable supply chain in the hotel industry in Sri Lanka, same searching for suggestions to improve suppliers' quality in the perishable supply chain in the hotel industry in Sri Lanka. Therefore, the study intends to fill the knowledge gap while also filling the context gap, in Sri Lanka, which provides insights for improving the quality of perishables in the field of practitioners, hotels, and supply chains.

RESEARCH METHODOLOGY

This section discusses a deeper into the conceptual framework, the hypotheses under evaluation, the methodology used, the research design, research philosophies, as well as data sampling and collecting techniques, culminating in the subsequent analysis.

Research Design

A research design is the setup of parameters for data collection and analysis to integrate relevance to meet the research objectives of the study. In current research there are three research objectives and based on that the conceptual framework and hypotheses have been aligned concerning past literature. The onion model helps the researcher to grasp the research design properly.

Research Philosophy

The researcher followed a positivist philosophy, applying quantitative methods, and statistical analyses to address the identified research objectives about supplier quality within the perishables supply chain of the hotel industry in Sri Lanka. Obtaining, real-world results helps practitioners in hospitality supply chain management to improve strategies for upgrading the quality of perishable food items within Sri Lankan hotels. Furthermore, the positivist approach makes the researcher comfortable by testing and presenting statistical results through the formulation of hypotheses.

Research Approach

The deductive research method has been used in this study, as the emphasis is placed on reviewing and studying existing hypotheses related to the investigated research title, which builds upon the work of others. The researcher then tests assumptions using a pre-established theoretical framework. The process involves identifying relevant theories, creating a conceptual framework, formulating hypotheses, and conducting analysis based on the collected data.

Research Strategies

A research strategy is a plan for achieving research objectives. Therefore, the researcher used a self-administered questionnaire to collect data, followed by a quantitative technique. Experimental strategy is the most practical way to use research strategy so that the main objectives are met, and hypotheses are proved, rejected, or verified.

Conceptual Framework

Figure 1 illustrates the theoretical structure and the relationship between the independent variables and the dependent variable.

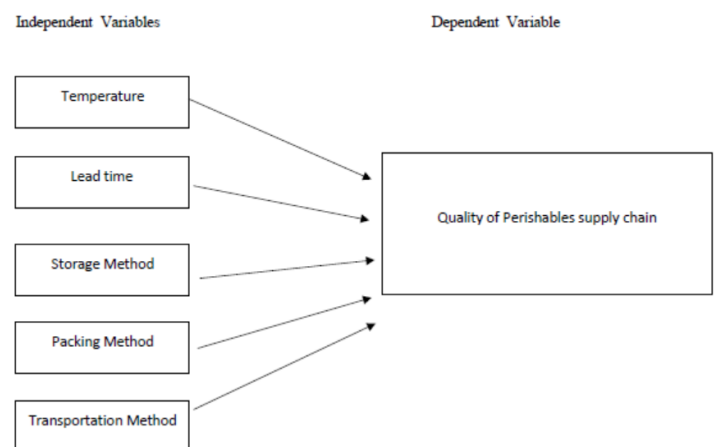


Figure 1 Conceptual Framework

Operationalization of Variables

It refers to the process of identifying and transforming the variables into measurable indicators. In this study, all five independent variables and dependent variables have been defined using 5-Likert scale measurements.

Research Hypothesis

Temperature

H0 – There’s no relationship between the temperature of the perishables and the quality perishable supply chain.

H1 – There’s a relationship between temperature of the perishables and the quality perishable supply chain.

Lead Time

H0 – There’s no relationship between the lead time of the perishables and the quality perishable supply chain.

H2– There’s a relationship between the lead time of the perishables and the quality perishable supply chain.

Transportation Method

H0 - There’s no relationship between the transportation method of the perishables and the quality perishable supply chain.

H3- There’s a relationship between the transportation method of the perishables and the quality perishable supply chain.

Storage Method

H0- There’s no relationship between the Storage method of the perishables and the quality perishable supply chain.

H4 - There’s a relationship between the Storage method of the perishables and the quality perishable supply chain.

Packaging Method

H0 - There’s no relationship between the lead packaging method of the perishables and the quality perishable supply chain.

H5- There’s a relationship between the lead packaging method of the perishables and the quality perishable supply chain.

Population

The population in this study is the upstream supply chain of hotels and restaurants in the Negombo and Colombo areas in Sri Lanka, specifically focusing

on the procurement section employees and chefs who directly work with perishable foods.

Sample Justification and Technique

The sample size of the study is 384 respondents which includes executive-level and managerial-level procurement sector employees and chefs from 3-star to 5-star hotels in the target sample. Out of 385, only 200 responded hence the study limited the selected sample size.

Data Collection Methods

The primary data collection is done through the distribution of a structured questionnaire among 385 people, and responses are to be collected through Google Forms. The questionnaire is divided into 3 parts. Part A focuses on the demographic background of the employees. Part B is designed based on independent and dependent variables, which are ranked using the Likert scale method. Part B question related to suggestions and recommendations to improve the perishable supply chain in the hotel industry in Sri Lanka.

Moreover, the researcher has referred to around 40 articles which means the secondary data are readily available from different online sources: scholarly articles, websites, research articles, etc.

RESULTS AND DISCUSSION

Validity and Reliability

Table 1 Reliability of factors

Variable Name	Cronbach’s alpha value	No of items
Temperature	0.704	3
Lead time	0.707	3
Transport method	0.710	3
Storage method	0.702	3
Packaging method	0.718	3
Quality of perishable supply chain	0.710	3

The study utilized Cronbach's alpha to assess data reliability, focusing on multiple Likert questions in a questionnaire with a quantitative approach to identify relationships between independent and dependent variables. Table 1 shows that the results of

Cronbach’s alpha value are more than 0.7 at the accepted level for 18 variables, which confirms the internal consistency of the question and the reliability of the data set. Also, the model is suitable as the residuals show no significant autocorrelation, as indicated by the value of 2.024. Descriptive Statistics of Variables

Table 2 shows that all independent components have a mean value of 4.3783, 4.1900, 4.1350, 4.1850, 4.1467, and 4.1833, with the packaging method having the highest deviation (0.61766). The quality of the perishable supply chain has a minimum deviation (0.53961), indicating less deviation. Skewness should be between +1 and -1, and results are considered normal if they are less than three times the standard error.

Table 2 – Descriptive Statistics

		Temperature	Lead time	Transportation method	Storage method	Packaging method	Quality of perishable supply chain
N	Valid	200	200	200	200	200	200
	Missing	0	0	0	0	0	0
Mean		4.3783	4.1900	4.1350	4.1850	4.1467	4.1833
Std. Deviation		.56481	.55467	.60714	.54265	.61766	.53961
Skewness		-2.674	-1.066	-1.378	-1.105	-.917	-1.254
Std. Error of Skewness		.172	.172	.172	.172	.172	.172
Kurtosis		12.372	4.597	4.609	5.086	2.536	5.390
Std. Error of Kurtosis		.342	.342	.342	.342	.342	.342

Correlation Analysis

Table 3 – Correlation Analysis

Correlations		QPS
Packaging Method	Pearson Correlation	.556**
	Sig. (2-tailed)	0.000
	N	340
Storage Method	Pearson Correlation	.545**
	Sig. (2-tailed)	0.000
	N	200
Lead time	Pearson Correlation	.506**
	Sig. (2-tailed)	0.000
	N	200
Temperature	Pearson Correlation	.462**
	Sig. (2-tailed)	0.000
	N	200
Transport Method	Pearson Correlation	.449**
	Sig. (2-tailed)	0.000
	N	200

Pearson Correlation analysis is used to identify the association between the dependent variable (perishable supply chain) and the identified five independent variables. Table 3 results show that there is a positive linear relationship between each factor and the quality of the perishable supply chain. The packaging method has the strongest positive impact followed by the storage method, lead time, temperature, and transport method, values provided 0.556, 0.545, 0.506, 0.462, and 0.449 respectively. The values are all significant at the 0.01 level (2-tailed), meaning a low probability of their occurrence by chance. Overall, these correlation coefficients offer significant insights into the variables that impact the quality of the perishable supply chain in the Sri Lankan hotel industry. By carefully controlling these variables, hotels can improve their overall customer experience.

Regression Analysis

Table 4 – Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.556 ^a	.309	.305	.44982	
2	.620 ^b	.384	.378	.42567	
3	.647 ^c	.419	.410	.41442	2.024

a. Predictors: (Constant), PM
 b. Predictors: (Constant), PM, STM
 c. Predictors: (Constant), PM, STM, T
 d. Dependent Variable: QPS

Regression analysis is used to explain the relationship between a dependent variable and one or more independent variables. Table 4 provides information about the goodness of fit of the model. The values 0.309, 0.384, and 0.419 for R Square indicate that the independent variables explain 30.9%, 38.4%, and 41.9% of the variance in the dependent variable, which is the quality of the perishable supply chain, respectively. Further, the model effectively explains perishable supply chain quality variation based on independent variables, with the Durbin-Watson statistic indicating autocorrelation in residuals.

Analysis of Variance

ANOVA is used to identify significant differences between the means of three or more independent groups. Table 5 displays F-test statistics for the regression model, indicating high significance with a probability of P = 0.000, less than 0.001. Also, it shows highly significant F-values (P = 0.000) for each

regression model, indicating that independent variables jointly influence the quality of the perishable supply chain.

Table 5 – ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	17.881	1	17.881	88.370	.000 ^b
	Residual	40.064	198	.202		
	Total	57.944	199			
2	Regression	22.249	2	11.125	61.395	.000 ^c
	Residual	35.695	197	.181		
	Total	57.944	199			
3	Regression	24.282	3	8.094	47.128	.000 ^d
	Residual	33.662	196	.172		
	Total	57.944	199			

Determination of Coefficient

The "Determination of Coefficients" table provides detailed regression model coefficients and collinearity statistics, including unstandardized coefficients (B)**, representing the estimated change in the dependent variable.

Table 6 – Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics	
		B	Std. Error	Beta	t		Tolerance	VIF
1	(Constant)	2.171	.216		10.031	.000		
	PM	.485	.052	.556	9.401	.000	1.000	1.000
2	(Constant)	1.475	.249		5.925	.000		
	PM	.315	.060	.361	5.265	.000	.666	1.503
	STM	.335	.068	.337	4.910	.000	.666	1.503
3	(Constant)	1.041	.273		3.806	.000		
	PM	.278	.059	.319	4.699	.000	.644	1.553
	STM	.261	.070	.262	3.734	.000	.602	1.661
	T	.205	.060	.215	3.441	.001	.762	1.312

The unstandardized coefficient for the constant in Model 1 is 2.171, indicating the expected value of the dependent variable when all independent variables are zero. The study uses t-values to test the significance of coefficients, with larger absolute t-values indicating more significant coefficients. In Model 1, the t-value for the coefficient of the Packaging Method (PM) is 9.401, indicating its high significance. The significance levels (p-values) are associated with each coefficient, with low p-values indicating significant differences from zero. For instance, all the coefficients in the three models have very low p-values (e.g., .000 or .001), indicating high significance. Collinearity statistics (Tolerance and VIF) assess multicollinearity among independent variables. Values close to 1 and VIF around 1 indicate no multicollinearity concerns in regression models.

Regression Model

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4$$

$$QPS = 0.278(PM) + 0.261(SM) + 0.205(T)$$

The quality of the perishable supply chain is estimated using a linear combination of independent variables, with coefficients (0.278, 0.261, and 0.205) representing their weights. This equation predicts perishable supply based on packing method (X1), storage method (X2), and temperature values (X3).

Table 6 explains the Variance Inflation Factor (VIF) and Tolerance which are used to assess multicollinearity. VIF measures the variance of an estimated regression coefficient, while Tolerance measures the proportion of variance in an independent variable not explained by other variables. The Multicollinearity Table shows that all VIF values are less than 10, indicating no multicollinearity concerns.

Table 7 – Multicollinearity

	Collinearity Statistics	
	Tolerance	VIF
Packing method	.644	1.553
Storage method	.602	1.661
Temperature	.762	1.312

Hypothesis Testing

Table 8 – Hypothesis Testing

Independent Variables	Pearson Correlation Coefficient	P Value	
Temperature	0.75	0.000	Significant
Lead Time	-0.60	0.000	Significant
Transport Method	0.85	0.000	Significant
Storage Method	-0.55	0.000	Significant
Packaging Method	0.70	0.000	Significant

The null hypothesis for each independent factor is rejected due to the repeatedly low p-values (all presented as 0.000), which reflect statistical significance at a chosen significance level and confirm a significant relationship with the quality of the perishable supply chain.

CONCLUSION

The study aimed to identify the most influential factor, assess the impact of suppliers' quality on the perishable supply chain, and suggest ways to improve suppliers' quality in the Sri Lankan hotel industry. Based on the findings, it was concluded that temperature is the most influential factor, and the packaging method and storage method have a significant impact on the quality of the perishable supply chain. It was also found that the transportation method has an insignificant impact on the quality of the perishable supply chain, while the lead time has an insignificant impact on the quality of the perishable supply chain. Therefore, based on the research findings and discussions presented in the study, the research objectives were justified. Further, the study recommends enhancing the quality of the perishable supply chain in Sri Lanka's hotel industry by sourcing directly from suppliers, implementing supplier rules, using technology, maintaining experienced staff, establishing government relationships, adopting suitable packaging methods, streamlining logistics, investing in high-quality packaging, and prioritizing food safety.

Future Research

In the future, researchers are required to investigate the relationship between perishable foods and food waste in hotel settings, as well as provide a deeper comprehension of the factors influencing perishable food quality and their specific consequences.

STUDY LIMITATION

The study on perishable items in Sri Lankan hotels has limitations, including a limited scope, data collection from executive and managerial staff, a sample size of 200 respondents, and a questionnaire designed to assume respondents' knowledge of perishable foods, which could limit the applicability of the findings to individuals with varying expertise levels.

DECLARATIONS

I hereby declare that appropriate acknowledgment of the secondary data has also been completed. I further declare that all the data included in this

study was previously not submitted for any degree program before this submission.

ACKNOWLEDGMENT

Firstly, it is my foremost duty to extend my gratitude to my supervisor Ms. C.D. De Silva for granting her continuous support and dedication throughout this study. Secondly, I'm grateful to the academic and non-academic staff members of the Department of Transport & Logistics Management, Faculty of Management, Humanities and Social Sciences and for the tremendous service rendered throughout. I would also like to express my gratitude to all the respondents who participated in the survey, for their valuable responses and opinions concerning the subject matter of the research. Finally, I would like to give my heartfelt gratitude to my family members and friends for their support and guidance throughout the study and to every individual who supported me in various forms throughout this effort to make it a success.

REFERENCES

1. Anish Kumar, S. K. M. P. K. S. K. (2020). Challenges in perishable food supply chains for sustainability management: A developing economy perspective. Wiley.
2. Anon. (2021). Wayaj News. [Online] Available at: <https://news.wayaj.com/green-hotels/food-waste-in-hotels/> [Accessed 2022].
3. Development, S. L. T. (2020). Sri Lanka Tourism Development Association. [Online] Available at: <https://www.sltda.gov.lk/en/annual-statistical-report> [Accessed 2022].
4. Julián Andrés Durán Peña 1, *, Á. O. B. 1. a. N. M. R. M. 2. (n.d.). Impact of Bullwhip Effect in Quality and Waste in Perishable.
5. Negi, S. (2019). Transportation lead time in perishable food value chains: an Indian perspective. *Int. J. Value Chain Management*, Volume 10, p. 290.
6. Norah Sullivan, R. B. O. (2011). IDB Invest. [Online] Available at: <https://idbinvest.org> [Accessed 13 December 2022].

7. Saurav Negi, L. C. W. (2019). Transportation lead time in perishable food value. *Int. J. Value Chain Management*, Volume 10.
8. Saurav Negi, N. A. (2016). Energy, Infrastructure and Transportation Challenges and Way Forward I 89 Factors Leading to Losses and Wastage in the Supply Chain of Fruits and Vegetables Sector in India. *Energy, Infrastructure and Transportation Challenges and Way Forward*, p. 89.
9. Anna Brzozowska, A. B. I. S. (2016). *Managing cold supply chain*.
10. Anon. (2019). U.S. Department of Agriculture. [Online] Available at: <https://ask.usda.gov/s/article/What-foods-are-perishable> [Accessed 2022].
11. Authority, S. L. T. d. (2019). Sri Lanka Tourism Development Authority. [Online]
12. Byrne, C. (2022). What are Perishable Foods, and How Should You Store Them? *Healthline*.
13. Handfield, R. (2022). NC State University. [Online] Available at: scm.ncsu.edu [Accessed 2022].
14. Jayalath, M. M. (2021). Mapping Post-Harvest Waste in Perishable Supply Chains through System Dynamics: A Sri Lankan Case Study. *The Journal of Agricultural Sciences - Sri Lanka*, pp. 526-543.
15. Kodithuwakku, S. S. A. W. (2014). Supermarkets and their Effects on Smallholder Vegetables Farmers in Sri Lanka. *Journal of Agriculture Economics and Rural Development*, p. 62.
16. Kune-Muh Tsai, K. P. (2018). Special issue on next-generation cold supply chain management: research. *The International Journal of Logistics Management*, Volume 29, pp. 786-791.
17. Lambert, D. M. (2001). Issues in Supply Chain Management. *Industrial Marketing Management*, pp. 65-83.
18. Lauren Xiaoyuan Lu, J. M. S. (n.d.). *Supply Chain Management*. Volume 22, pp. 15281-15285.
19. Lemma, Y. (2014). Loss in Perishable Food Supply; An Optimization Approach. *Academia*, Volume 5.
20. Li, B. (2018). Why hotel food and beverage is on the rise. [Online]
21. McCombes, S. (n.d.). Scribbr. [Online] Available at: <http://scribbr.com> [Accessed 2022].
22. Myo Min Aung, Y. S. C. (2014). Temperature management for the quality assurance of a perishable. *Food Control* 40, pp. 198-207.
23. O.J, P. H. &. (n.d.). The challenges faced by hotel service industry. *International Journal of Tourism Sciences*.
24. Park, H. U. &. O.-J. (2018). The challenges faced by hotel service industry in. *International Journal of Tourism Sciences*.
25. Qualtrics.xm. (2022). Qualtrics.xm. [Online] Available at: qualtrics.com [Accessed 2022].

Factors affecting on Container Inventory Management (CIM): Evidence from Container depots in Sri Lanka

Gunathilake K.A.K.M¹, Siriwardana S¹,

Department of Logistics and Transport/ CINEC Campus

roshan.siriwardnea@cinec.ed

ABSTRACT

Container inventory and management (CIM) is an integral part of running a successful container logistics operation, allowing for best-in-class container utilization and low-cost operations. Ineffective container inventory management has become a fairly widespread concern in the shipping industry. carrier's extensive fleet is essentially useless if it is not managed effectively and efficiently. The container inventory can be managed effectively to maintain a smooth balance between supply and demand while reducing potential extra expenses by adhering to efficient and effective procedures. This paper proposes some factors affecting to container inventory management [CIM] in Container depots in Sri Lanka. Accordingly, a target population of 384 senior employees in the field are followed by a questionnaire survey have been carried out and data were analyzed mainly using Chi-Square test. Researcher believes that responses received by employees whom with experience more than 10 years can highly influence on the output of the study based on judgmental sampling method.

Data analysis, reliability analysis, demographic factor analysis, descriptive statistical analysis, cross tabulation analysis, and correlation analysis. Chi-square testing and multiple regression analyses were used. With the expertise point of view, this study would lead to understand the factors influence on CIM. After clear analysis, the study concluded four factors namely, demand and supply of containers, high shipping rates, imports and exports trends and cargo seasonality have an influence on the container inventory management. It's acceptable that no any party can completely avoid such consequences, but the researcher believes that with proper identification and planning accordingly, this ineffectiveness of container inventory management can be lessened or controlled. With no doubt, taking

proactive measures will positively impact on container industry of Sri Lanka as well as the economy of the country.

Index Terms- Container Inventory Management [CIM], Demand And Supply Imbalance, Efficiency

INTRODUCTION

According to (Anon., 2016) Sri Lanka is located at the crossroads of international shipping lines that connect East and West. Because of its location, Sri Lanka can provide swift and effective global and regional connectivity to carry freight from Asia to the rest of the globe. This is partly due to the country's location at the crossroads of all major sea routes connecting Asia to the rest of the world, as illustrated in the map below. Furthermore, Sri Lanka's proximity to all major ports in the Indian subcontinent, particularly those in India, gives it a strategic site capable of providing rapid and easy connectivity to the Indian subcontinent via its feeder network. Maritime Transportation has been a focal point in world trade. According to the statistical data of UNCTAD, over 80% of world trade is operated through Maritime Transportation.

Running a successful container logistics operation requires careful container inventory management (CIM) to enable best-in-class container utilization and cost-effective operations. Inability of performing a proper balanced Container Inventory Management system [CIM] is leading to a failure in the industry of maritime. In Container Inventory Imbalance [CII], the operator is unable to have a balance between the demand and supply of the containers. When the consignee places the order the operator will release the containers for the export process and when the cargo arrives at the port of destination, the consignee will unload the cargo and handover the empty container back to the yard of the specific operator. And depending on the requirement, then the containers will be transported to another destination or will be Empty Repositioned. (Edirisinghe, 2018) If containers are

constantly moving with freighted cargo, the optimum "utilisation" of inventories can be accomplished. This whole cycle of process should be managed properly in order to reduce the level of CII. At each and every stage of this process, it incurs a cost. In contrast, this paper focuses on the factors that influence the container inventory imbalance [CII] by taking the participating shipping lines' predicted and current container inventory data to make the "matching" of demand and supply more realistic (Edirisinghe, 2021). Also the way to take improving steps for a better container inventory management [CIM] by lowering overall costs and minimizing excess to avoid economic loss. In order to propose proactive solutions, a complete analysis of the variables empty container (MTY) repositioning, volatile trading patterns worldwide, container fleet size, international trade patterns, uncertainties of customer demands, and dynamic nature will be taken into consideration.

Research strategy is simply the plan to achieve the objectives of the research. Since here the researcher uses a questionnaire to collect data, it has a quantitative technique. According to (Saunders, et al., 2016) there are many research approaches as experimental, action, case study, grounded, and ethnography. According to the background research, the researcher discovered that the "Experimental Strategy" is the most practical way since experimental research entails changing one variable to observe a change in another variable. In simple terms, to analyze the connection between variables. The main objective of experimental research would be to prove, reject, or verify the developed hypothesis. From the data collected, its attempt is to study the relationship between the independent variables towards the container inventory management.

RESEARCH METHODOLOGY

Research Approach

Deductive and Inductive methods can be used to conduct a research. In a deductive research technique, the researcher may emphasis on what someone else done and study existing hypotheses regarding any topic the researcher is investigating, and then test assumptions using a hypothetical framework. The primary goal of the inductive approach is to generate hypotheses based on scientific information acquired through quantitative approaches (Saunders et al, 2016). In here researcher has identified the relevant theories. After then the conceptual framework has been developed. Following the conceptual framework, the hypotheses being prepared. After then based on the data collected the analysis is carried out.



Figure 1 Research Approach

Conceptual Framework

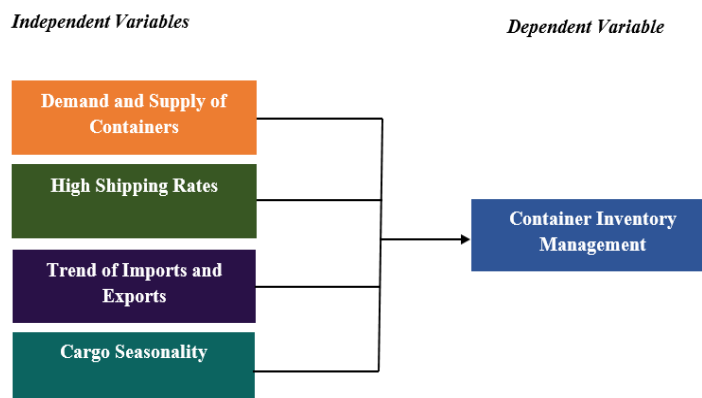


Figure 2 Conceptual Framework

In here the researcher has distributed the questionnaire with the senior managers, employees from the container shipping industry, shipping lines and container depots of Sri Lanka. Therefore, the responses received from these targeted populations will be taken in to consider. In here, the population is taken as an unknown value. Filtering through the population, the respondents with more than 10 years of experience will be chosen as the research population. The researcher believes that if the questions are answered by respondents who are aware of the study, the study will have a reliable influence. Therefore, the researcher believes that the employees with more than 10 years of experience in the field of shipping and container industry has proper knowledge and experience regarding the research study area.

Sample Justification and Technique

The researcher only analyzes responses from employees who have working experience for more than ten years out of a sample size of 384. In that case, the researcher believes that individuals with more than ten years of experience in the shipping and container business have adequate knowledge and experience in the research topic area.

Because the outcome of the research to meet the objectives is dependent on the data provided by the respondents, the respondents' expertise is critical. As a result, the research employs the judgmental sampling technique to conduct the final output analysis. The population will include senior employees with moderate to high levels of experience. Their experience will be margined as those with more than 5 years of experience. It is a non-probability sampling technique in which the researcher chooses units to sample based on prior knowledge or professional judgment.

Primary Data Collection Method

A well-structured questionnaire is the main tool the researcher uses to collect data. A "web-based questionnaire" is used to conduct the survey. Focus group discussions included a cross-section of senior managers, employees from the container shipping industry and container depots of Sri Lanka.

- **Collection of Data Through Questionnaires**

This strategy includes sending a questionnaire to the individuals selected in the sample population to get their feedbacks and knowledge based on their experience in the container industry. The questionnaire is divided into three sections, the first of which provides an overview of the researcher who collects data and the objective of the questionnaire. Section 02 of the questionnaire has 5 questions designed to elicit demographic information from the responder. Section 3 includes 15 questions with three questions each on the four independent variables and one dependent variable. This straightforward questionnaire design contributed to the study's high response rate. The Likert scale ranged from 1 to 5, and respondents were asked to indicate their preferences.

Secondary Data Collection Method

Table 1 Cronbach's Alpha Value

Dimension	Cronbach's Alpha Value	Number of Items	Internal Consistency Level
Imbalanced Demand and Supply of Containers	0.708	3	Acceptable
High Shipping Rates	0.712	3	Acceptable
Trend of Imports and Exports	0.740	3	Acceptable
Cargo Seasonality	0.773	3	Acceptable
Container Inventory Management	0.831	3	Good

The secondary data sources listed below provide invaluable support for the researcher's topical research. Secondary data are those that are already in existence; that is, they are those that have already been gathered and examined by another party. As a result, more than 50 publications on various aspects of CIM have been referred. The researcher for this study will make use of secondary data that is available at the referred to the shipping industries.

Online research materials

- Research reports
- Scholar articles
- Web sites
- Annual reports
- Statistical data from the websites of container depots, main shipping lines

Validity and Reliability

Likert scale questions are used in the study to establish variables. To ensure internal consistency, the direction of the questions should be verified against the variable. The Alpha Cronbach's alpha is used to calculate this. According to (Kothari, 2004), an Alpha Cronbach's value greater than 0.6 is regarded a high dependability and acceptable index. A value of Alpha Cronbach less

than 0.6 is considered low. Alpha Cronbach's alpha scores between 0.60 and 0.80 are considered moderate yet acceptable. Although Alpha Cronbach's alpha values between 0.8 and 1.00 are considered very good.

Table 2 Descriptive Statistics Summary

Statistics		Imbalanced Demand and Supply	High Shipping Rate	Trend of Imports and Exports	Cargo seasonality	CIM
N	Valid	368	368	368	368	368
	Missing	0	0	0	0	0
Mean		3.9638	3.8089	4.0507	3.8895	4.0625
Std. Deviation		.61999	.67524	.58632	.65140	.58595
Variance		.384	.456	.344	.424	.343
Skewness		-.791	-.801	-1.058	-1.077	-.921
Std. Error of Skewness		.127	.127	.127	.127	.127
Kurtosis		1.295	.732	1.572	1.683	1.266
Std. Error of Kurtosis		.254	.254	.254	.254	.254

Correlation Analysis

Correlation analysis is a statistical evaluation approach used to determine the availability and strength of a relationship between two variables. This method is also used to determine whether there is a substantial relationship or pattern between two variables.

Regression Analysis

Regression analysis is used to determine the strength of the link between the independent and dependent variables. It can also be used to evaluate the strength of the relationship between variables and to forecast their future relationship.

RESULTS AND DISCUSSION

Reliability Measurement of Variables Descriptive Statistics of Variables

Mean

According to the SPSS output in this calculation, the highest mean value is with the variable container inventory management. And also it's clear that all the variables have a high mean value around 4. Taking one example, the mean of demand and supply of containers is recorded as 3.9638. That means as this is resulted from a 5 likert scale, respondents have rated the imbalanced demand and supply of containers as 3.9638 out 5. Higher the value of mean is higher the level of acceptance.

Standard Deviation

And the standard deviation, the variable the high shipping rate has the highest standard deviation of .67524 whereas the container inventory management has the lowest standard deviation. Standard deviation is the dispersion value of the specific data from the mean value. If the mean value and the standard deviation value of cargo seasonality are 3.8895 and 0.65140 respectively, it implies that data of individual data are dispersed at a value distance of 0.65140 from the mean value. If the standard deviation is meant to be high, that's unhealthy for the result.

Skewness

Positive "Skewness" value explain that distribution of the tail is right side and the negative "Skewness" value explains the left side of the distribution tail. Demand and supply of containers, high shipping rate, cargo seasonality have negative skewed values which are left tailed. And the Trend of Imports and Exports and CIM have positive skewed valued which means positive tailed.

Table 3 Skewness Analysis

Dimension	Value	Skewed Level	Tail
Demand and supply of containers	-0.791	Moderately Skewed	Left Tailed
High shipping rate	-0.801	Moderately Skewed	Left Tailed
Trend of imports and exports	-1.058	Moderately Skewed	Left Tailed
Cargo seasonality	-1.077	Moderately Skewed	Left Tailed
CIM	-0.921	Moderately Skewed	Right Tailed

Demand and supply of containers, high shipping rate, cargo seasonality have negative skewed values which are left tailed. And the Trend of Imports and Exports and CIM have positive skewed valued which means positive tailed.

Table 4 Correlation Measurement

Value of Correlation	Interpretation
r = +1	Perfectly Positive
r = [0.70-1.00]	Strong Positive
r = [0.50-0.70]	Average Positive
r = [0.00-0.50]	Weak Positive
r = - 1	Perfectly Negative
r = -[0.70-1.00]	Strong Negative
r = -[0.50-0.70]	Average Negative
r = - [0.00-0.50]	Weak Negative

Kurtosis

Table 5 Kurtosis Analysis

Dimension	Kurtosis Value [Absolute Value]	Std. error of Kurtosis	Kurtosis Level
Demand and supply of containers	1.295	0.762	Normally Distributed
High shipping rate	0.732	0.762	Normally Distributed
Trend of Imports and Exports	1.572	0.762	Normally Distributed
cargo seasonality	1.683	0.762	Normally Distributed
CIM	1.266	0.762	Normally Distributed

Multicollinearity Diagnostic Test

Abbreviations:

- Demand and supply of containers - DS
- High shipping rate - SR
- Trend of imports and exports- EI
- Cargo seasonality- CS
- Container Inventory Management- CIM

Correlation analysis between independent variables and dependent variable, container inventory management.

Regression Analysis

Table 6 ANOVA Summary

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35.146	4	8.787	35.104	.000 ^b
	Residual	90.861	364	.250		
	Total	126.007	368			
a. Dependent Variable: CIM						
b. Predictors: (Constant), CS, DS, EI, SR						

R Value

R value implies the linear relationship between the variables, whether they have a positive relationship or negative relationship. If $R \geq 0.5$, there's a good relation. As per the model summary, the "R" value is significant at the level of 0.528.

R Square Value

R Square value illustrate that 27.9% of the variation of Container Inventory Management is explained by the four independent variables. Adjusted R Square is 0.271, which can be explained as model goodness is 27.9%, and moderate level of impact between dependent and independent variables. Since the difference between the R square value and the adjusted R square value is low, it can be considered that the effect of confounding variables is low within the model.

Durbin – Watson

Durbin –Watson predicts the future values from the current values [auto correlation]. Durbin –Watson test statistics is 1.720 and the value is between 0 and 4. Since the above values in between 0-2, it's positive auto correlation. Therefore, since a pattern can be identified the future values can be predicted. Also, residuals can be identified as independent and the result will be more appropriate.

Table 7 Correlation analysis

Dimension	Test Statistic [Correlation]	Significant [2 - tailed]	Status
DS → CIM	0.334	0.000	Weak Positive
SR → CIM	0.287	0.000	Weak Positive
EI → CIM	0.389	0.000	Weak Positive
CS → CIM	0.433	0.000	Weak Positive

ANOVA

As per the table outcome significance level of 0.00, which is less than 0.05, which means the null hypothesis H_0 is rejected. Further it describes that at least one independent variable has a gradient value which mean there is significant association between the identified four independent variables and the dependent variable, container inventory management. F value is 35.104, which signifies that the independent variables and container inventory management are significantly correlated.

Coefficient

The coefficient table shows the coefficient values of each independent variables and the way they impact on the dependent variable. The below hypothesis can be built.

$$H_0; \beta_1 = \beta_2 \dots \dots \beta_k = 0$$

$$H_0; \beta_1 = \beta_2 \dots \dots \beta_k \neq 0$$

Where,

β =slope of the model

k=number of independent variables

According to the table, individual β value probability of imbalanced demand and supply of containers is 0.00, this is significant at 5% significant level (95% confident level) and it comprises is 0.181 of individual β value. Therefore, the null hypothesis is null hypothesis H_0 is rejected. This indicates that imbalanced demand and supply of containers has significant positive effect on container inventory management.

The individual β value probability of high shipping rate is 0.00, this is significant at 5% significant level (95% confident level) and it comprises is 0.045 of individual β value. Therefore, the null hypothesis is null hypothesis H_0 is rejected. This indicates that demand and supply of containers has significant positive effect on container inventory management.

According to the table, individual β value probability of trends of exports and imports is 0.034, this is not significant at 5% significant level (95% confident level) and it comprises 0.045 of individual β value. Therefore, the null hypothesis H_0 is not rejected and alternative hypothesis is accepted. This indicates that trends of exports and imports has significant positive effect on container inventory management.

The individual β value probability of cargo seasonality is 0.00, this is significant at 5% significant level (95% confident level) and it comprises is 0.220 of individual β value. Therefore, the null hypothesis is null hypothesis H_0 is rejected. This indicates that demand and supply of containers has significant positive effect on container inventory management.

According to the standardized coefficient of β , most influencing factor seems to be the cargo seasonality and the least influencing factor seems to be the shipping rate.

Following Linear Regression Model can be developed according to the unstandardized coefficients.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

$$Y = 1.358 + 0.181 X_1 + 0.045 X_2 + 0.220 X_3 + 0.238 X_4$$

Where,

- Y = Container Inventory Management
- X₁ = Demand and Supply of Containers
- X₂ = High Shipping Rate
- X₃ = Exports and Imports
- X₄ = Cargo Seasonality

The above equation implies the level of impact of each independent variable on the dependent variable. In one scenario, if the variable demand and supply of containers is increased by 1 unit, the container inventory management will have increased by 0.181. So on if exports and imports is increased by 1 unit, the container inventory management will have decreased by 0.220.

Since all the tolerance values are greater than 0.2, we can conclude that all the values are normally distributed. Because all of the Variation Inflation Components (VIF) are less than 5, independent factors are not correlated. As a result, there is no multi co-linearity problem in the regression model.

Table 8 Regression Model Summary

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.528 ^a	.279	.271	.50030	1.720
a. Predictors: (Constant), CS, DS, EI, SR					
b. Dependent Variable: CIM					

Table 9 Hypothesis Testing Summary

Variable	Hypothesis	Chi Square Significance value	Summary
Demand and Supply of Containers	H_0 ; Null H_1 ; Alternative	0.000	H_1 ; Alternative is accepted
High Shipping Rates	H_0 ; Null H_1 ; Alternative	0.000	H_1 ; Alternative is accepted
Trend of Imports and Exports	H_0 ; Null H_1 ; Alternative	0.000	H_1 ; Alternative is accepted
Cargo Seasonality	H_0 ; Null H_1 ; Alternative	0.000	H_1 ; Alternative is accepted

Hypothesis Testing

Table 10 Hypothesis Dimensions

Dimension	Impact
Demand and Supply of Containers	Positive
High Shipping Rates	Positive
Trend of Imports and Exports	Positive
Cargo Seasonality	Positive

With the analysis of hypothesis with Chi- Squared significance value, it was decided whether to accept which hypothesis. Likewise, all the independent variables were tested and accepted the alternative hypothesis as their significance values were less than 0.05. It implies that there’s a relationship between all the independent variables and the dependent variable.

CONCLUSION

The end outcome was beneficially aligned with the researcher's point of view. This means that when demand and supply increases, CIM is also increases because of resulting a container inventory imbalance. With the expertise view point received by the researcher, it can be concluded that this factor has adverse impacts on the container inventory management. With price increase, their rate of impact is responded as a high value which implies that it has a high significant impact on CIM. The researcher suggests this condition as an influence factor on CIM based on the situation in Sri Lanka, particularly the government-imposed bans. Even experts in the field have agreed with the researcher based on their own experience. As a result of the aforementioned investigation, it has been determined that it is an influencing element on CIM. To comment on shipping seasonality, researchers highlighted two major seasons: Chinese New Year and Christmas. It's evident that this is not the usual throughout the holiday season. The shipping container sector, like other industries, is being impacted. For example, during the Chinese New Year, all manufacturing and exports are halted due to their holiday seasons. Keeping containers in China at that time is wasteful. As a result, container inventory must be effectively maintained in order to minimize the effects. This adverse impact is examined in relation to the experience of senior personnel above, and it is proven that there is a relationship between cargo seasonality and CIM.

This research focused on the factors affecting the efficiency of container inventory management. It must be addressed because it has become a concern as a result of Sri Lanka's economic inflation. This study emphasizes the importance of these factors on a better CIM system.

STUDY LIMITATIONS

The researcher attempts to identify where the research is constrained by highlighting the study's limitations. They are the limitations on generalizability and usability of findings that emerge from the design of the study and/or the method employed to ensure internal and external validity.

Contextual Limitation

International shipments of goods, particularly in the maritime industry, rely heavily on container transit. Even though there are many concepts in logistics industry, the researcher has limited its context to container inventory management. Containers are transported in many modalities, it is primarily and efficiently done through the maritime industry. Therefore, the research is carried down within the maritime field.

Geographical Limitation

Though shipping is available all over the world, the researcher focused on the shipping industry in Sri Lanka. The research will focus on container inventory management in Sri Lanka. In Sri Lanka, the containers handled through the Colombo port will be primarily targeted. Because of Sri Lanka's strategic location, the container handling and shipping industry contributes significantly to the country's income. As a result, the researcher's ultimate purpose is to improve management of containers.

Population and Sample Limitation

Despite the fact that there are numerous parties involved with shipping industry, container handlers and owners are primarily responsible for utilizing their containers. As a result, all depots involved in the container handling will be the researcher's population, while the parties handle over 50,000 TEUs will be the study population.

Time Limitation

The researcher used statistical data from the year 2021 to continue the research approach and to assess the contributing aspects. The researcher assessed the impact of the addressed issues in there by limiting it to 2021.

ACKNOWLEDGEMENT

It is great pleasure to complete the final version of the research report and in this juncture, it is my duty to convey my sincere gratitude to those who has extended their fullest support and guidance to complete this task. Firstly, I would like to render

my sincere gratitude to my supervisor Mr. Sampath Siriwardene for his continuous support and guidance throughout the study. I would also convey my gratitude to Mrs. Lakshmi Ranwala for her professional inputs in completion of this research study in data analysis.

Next, I extend my thanks to all the academic and non-academic staff of the Department of Logistics and Transport, CINEC Campus for the tremendous service rendered throughout the study period. My sincere gratitude goes to Mr. Srimal Asanka, Manager in Inventory Control at METRO Logistics International (pvt) Ltd.

My special thanks goes to all respondents, senior employees in reputed container lines, container depots and shipping lines for their time spend in responding my questionnaire. I would also like to give my heartfelt thanks to my family members and friends for their support and guidance throughout the study.

DECLARATION

I hereby declare, this dissertation is a piece of my own work, which I conducted independently, without the participation of any other member or members, as a requirement for the completion of the degree program, BSc in Logistics and Management. The references acquired from other related studies have been properly acknowledged in this research. In addition to that, proper acknowledgment of the secondary data has also been carried out. I further declare that any of the information presented in this research has not been submitted for any other degree program prior to this submission.

REFERENCES

1. Anon., 2016. Sri Lanka: A Logistics and a Maritime Hub. *Ministry of Foreign Affairs*.
2. Bhowmick, S., 2022. Understanding the economic issues in Sri Lanka's.
3. Mathugamage, N., & Siriwardena, S. (2023). Analysis of the factors affecting to logistics service quality based on unaccompanied passenger baggage warehouses in sri lanka. *DI.lib.uom.lk*.
<http://dl.lib.uom.lk/handle/123/21613>

4. Identify the CLIA's Efforts Towards to Mitigate the Environment Impact by Cruise Tourism Industry, Hansika Nirmani, Damsi Dharmaratne, Sampath Siriwardena, 2021. CINEC Campus.
5. Bingzhou, L., 2008. A Stochastic Model for Dynamic Capacity Allocation of Container Shipping Two-Dimensional Revenue Management.
6. Clarkson, 2020. Container Demand Trade.
7. COMMERCE, D. O., 2021. International Trade Statistics.
8. FREIGHT, S., 2022. International Shipping and Chinese New Year: Considerations for Your Business.
9. Intelligence, M., 2022. *Sri Lanka Freight and Logistics Market study*.
10. Jin, M., 2018. Trading Patterns Change.
11. Kabir, S. M. S., 2016. *Methods of Data Collection*. s.l.:s.n.
12. Kim, J.-H., 2018. Studies on Supply and Demand Paradox in Shipping Market.
13. Kothari, C. R., 2004. Research Methodology.
14. Larsen, S., 2021. How to pick the right shipping container. *GREENCARRIER BLOG*.
15. Monios, J. & Yuhong Wang, 2014. *Regional Stakeholder Solutions to Empty Container*. s.l.:s.n.
16. Moorthy, R., 2022. Rising sea freight rates expected to normalise by 1H 2022.
17. Mulder, J. & Dekker, R., 2016. Optimization in container liner shipping.
18. Raunglerdpanyagul, W., 1985. The Seasonal Pattern of Shipping Freight Rates.
19. Raunglerdpanyagul, W., 1985. The Seasonal Pattern of Shipping Freight Rates.
20. Saunders, M., Thronhill, A. & Lewis, P., 2016. Research Methods for Business Students.
21. Shipping, H., 2023. Chinese export container rates drop 27% as usual Lunar New Year cargo rush fails.
22. Soloviova, L., 2020. Container Transport System as a Means of Saving.
23. Song, D.-P., 2015. Empty Container Repositioning.
24. Tabachnick & Fidell, 2001. Using Multivariate Statistics.
25. Tavakol, M. & Dennick, R., 2011. Making sense of Cronbach's alpha.
26. Theofanis, S. & Boile, M., 2008. Empty marine container logistics: facts, issues and management strategies.
27. UNITEDNATIONS, 2021. Review of Maritime Transport.
28. Yin, J. & Shi, J., 2018. Seasonality patterns in the container shipping.

Original Article

Gypsy: AI-Powered Virtual Assistant for Windows OS

Madushan V.P.T¹, Gunasekara S.V.S¹, Fernando B¹

¹Department of Information Technology, CINEC Campus
t.madushan.1997@gmail.com

ABSTRACT

The proposed virtual assistant software, powered by AI, is specifically crafted for users operating Windows computers to enhance the efficiency and safety of their tasks with minimal input. This innovative design allows users to swiftly and effortlessly accomplish various everyday computer-based activities. Examples include streamlined online ordering, accessing desktop and web applications, conducting web searches, setting reminders, obtaining live directions, reading notes, checking weather forecasts, translating words, performing mathematical calculations, setting alarms, receiving the latest news, and sending emails and WhatsApp messages, among other functionalities. Furthermore, the project incorporates the ability to recognize both voice and text input commands. Users can interact with the system through voice commands captured by the computer's microphone, which are then converted into text output. This conversion facilitates the system in comprehending the input and executing the requested task. The tool is seamlessly integrated with the Internet and the Windows operating system, ensuring the delivery of the desired functions and results in response to user queries.

Index Terms- *Artificial Intelligence, Natural Language Processing, Speech Recognition, Context-aware Computing, Deep Learning, Virtual Assistant*

INTRODUCTION

There is a growing utilization of Artificial Intelligence (AI) technology that mimics human engagement with machines. This technology enables interaction with systems through various means, including voice, communication, and body or facial expressions. It facilitates smoother and

more effortless completion of tasks when humans engage with computers, telephones, and other electronic devices. The modern concept of virtual assistant software is based on the same AI technology. It learns to engage with people by becoming their personalized Assistant by studying their activities, routines, and behaviors. Famous examples of virtual assistant software in the modern era of technology include Google Assistant, Microsoft Cortana, Amazon Alexa, and Apple Siri. They facilitate using it, including web browsing, phone calls, opening programs, setting reminders, etc.

I. RELATED WORK

A. *Initial Research on Software Implementations Made for the Virtual Assistants*

Abishek Narayanan's exploration of "Virtual Personal Assistant" delves into the foundational techniques employed by context-aware computing using MFCC and NLP. To enhance spoken word accuracy, the programme integrates neural network-based speech recognition with machine learning-based lip movement detection. The four components that make up this system are voice input, detection, deduction, execution, and output [1]. Using machine learning and artificial intelligence, [2] discussed in "Virtual Personal Assistant with Facial Recognition Login System." The key objective is to provide a secure two-phase login process. In the first stage, a simple username and password login is utilized, and in the second, user-specific facial detection logic is applied. Also, it offers real-time weather updates, news, a to-do list, a search, and some entertaining movie trailers.

[3] An effort has been made to develop an intelligent voice-driven virtual personal assistant utilizing Python. This assistant empowers users to retrieve information, control devices through voice

commands, and execute desktop operations. The key components include the speech recognition module, the Python backend, API calls, and context extraction. Additionally, it encompasses features such as to-do lists, calendar events, file management, and email organization.

Manasa Sri Vardhan Kottamasu and C. K. Gomathy detailed the process of constructing a Python-based voice-enabled personal assistant for PCs. The system makes use of APIs for a variety of tasks, including calculations and retrieving news quotations from websites. Moreover, users can interact with the API to obtain specific outputs and send requests. This personal assistant enables users to pose questions in a conversational manner, with capabilities such as opening apps, reading news, taking notes, and performing Google searches. [4].

[5] the proposal introduces the "Voice Assistant" tool developed with Python, artificial intelligence, and natural language processing speech recognition techniques. The model employs three distinct working modes: supervised learning, unsupervised learning, and reinforcement learning. Integrating of natural language processing, machine learning, and deep learning concepts plays a crucial role in accomplishing various tasks. Moreover, this assistant boasts functionalities such as sending emails, web searches, setting alarms, providing weather updates, and replaying YouTube videos.

B. Commercial Research on Software Implementations Made for the Virtual Assistant

This is a list of the top five widely used and well-known apps that are similar to one another:

Google Assistant - Google introduced this widely-used AI-driven virtual assistant software in 2016. Users commonly interact with the Google Assistant through natural speech. The Assistant can facilitate changes to the hardware settings of the user's device, provide answers to hardware-related queries, display information from the user's Google account, and offer additional functionalities. This tool predominantly operates with Cloud APIs developed by Google. This study explores the utilization of Google Cloud APIs, including the Speech-to-text API, Translation API, Geolocation API, Weather

API, and more. Mobile and smart home devices are where it is mainly available. Accessibility is one of Google's strengths. You may use it in your car, phone, speaker, watch, laptop, or TV. It can link to regularly used products or applications like Netflix, YouTube, and Spotify [6].

Apple Siri - For virtual assistants that leverage AI technology, it is yet another excellent research tool. Voice queries, gesture-based control, focus-tracking, and a user interface in natural language are all used to direct requests to different Internet services can provide answers, make recommendations, and complete tasks. Advanced machine learning methods, such as compressed neural networks and long-term memory, are used by the voice recognition system [6].

Microsoft Cortana- Microsoft developed this well-known virtual assistant application in 2014. The name Cortana is derived from a video game character from Microsoft's Halo. For tasks like setting reminders and responding to user inquiries, it makes use of the Bing search engine. The Cortana tool keeps track of semantic search information using Satori to capture natural processing abilities. This study briefly describes the operation of the virtualAssistant program on the Microsoft operating system [6].

Amazon's Alexa - Amazon has done an excellent job in developing Alexa. This virtual assistant can connect our whole lives to some devices. Alexa is particularly popular in home automation systems since it can connect a massive number of devices such as lights, televisions, and many other electrical appliances. It can also check the weather, news, and connect you to the latest music on the market. It can also perform shopping and order a cab for a user based on voice commands.

Samsung's Bixby - Bixby is a one-of-a-kind virtual assistant. It has all of the typical characteristics of a virtual assistant. However one of Bixby's most remarkable features is that it can recognize landmarks and other visuals simply by photographing them. You may also aim your camera towards an object to see other price alternatives. The Google Assistant also provides translations of many languages. It can also suggest

restaurants and companies in the area and help you manage your schedule.

METHODOLOGY

This section outlines the methodological approach to developing a virtual assistant software endowed with artificial intelligence (AI) capabilities. The project's intent is to overcome prevalent limitations of existing AI applications within the Windows Operating System, aiming to deliver a solution that approaches the ideal of 100% user satisfaction.

Utilizing Python as the core programming language, the software is architected to integrate seamlessly into the Windows environment. It leverages natural language processing (NLP) techniques for interpreting user commands, recognizing speech, and rendering decisions based on key elements identified within the user interaction. Speech-to-text and text-to-speech conversions are executed using the Google speech recognition API, supplemented by relevant Python libraries. A context-aware computing approach is paramount, enabling precise discernment of user input, both spoken and typed, and the correction of mispronunciations.

The construction of the system's functionalities is dependent on the utilization of Python libraries, modules, and APIs that facilitate AI processes, including chatbot operations. The system's distinctiveness is further enhanced by the integration of deep learning and machine learning technologies, which contribute to the generation of dynamic responses to user queries. The incorporation of a neural network, a sophisticated deep learning algorithm, lies at the heart of this dynamic response generation mechanism. The responses are structured within a JSON dataset, designed as a training model, and are interfaced with the main module to provide relevant responses.

The user interface of the virtual assistant is crafted through the tkinter GUI toolkit, which translates complex backend operations into a navigable front-end experience, emphasizing chatbot interaction. This virtual assistant is crafted to eliminate redundancy in command entry, enabling users to

engage with the software efficiently through multitasking.

The "Gypsy" system distinguishes itself from other market offerings through a broad suite of functionalities, particularly excelling in processing online orders—a capability it exhibits through integration with renowned e-commerce platforms for order placement via voice or text commands. The versatility of "Gypsy" is manifested in its ability to support a variety of tasks:

- Information retrieval with or without a web browser
- Email and WhatsApp messaging services
- Weather forecasting and real-time news updates
- Directional guidance using mapping services
- Execution of mathematical computations
- Alarm setting and system information display
- Desktop management, including wallpaper changes and power options
- Application launching and text translation
- Creation of task lists and shopping lists
- Capturing of screenshots and webcam selfies
- Providing entertainment via jokes, music, and video streaming

Critically, the "Gypsy" system assures comprehensive data security. It ensures that only data supplied during the initial registration is conserved, and no subsequent user activity data is stored, thereby affirming its commitment to user privacy and data integrity.

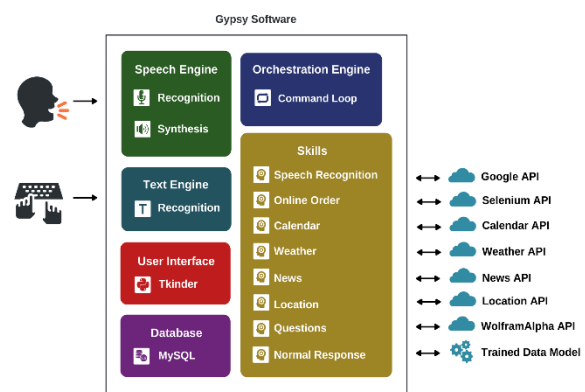


Figure 1: Main Components of the Gypsy Software

RESULT AND ANALYSIS

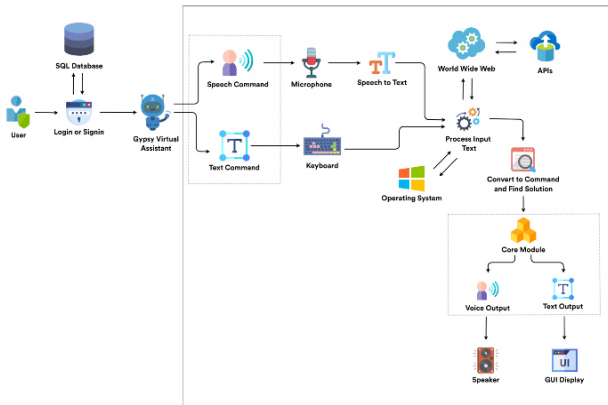


Figure 2: System Architecture Diagram

The initial step for users is the installation of the application on a Windows-based computer. Following installation, users encounter the welcome screen, which presents options for account creation or existing account login, where one is required to provide personal details such as a username, email, and password.

and system resources. The resultant outputs are then relayed back to the user via the chosen command modality. This interaction continues uninterrupted until the user opts to log out or close the application.

A case in point is application or webpage launching: upon receiving the command "open" followed by the name of the application or a recognized website, the system accurately discerns and initiates the requested program.

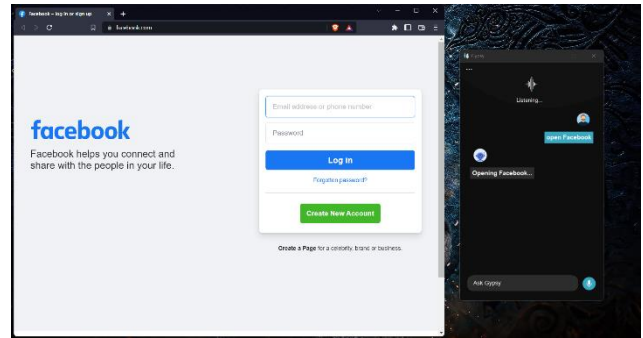


Figure 4: Launching Application or Website

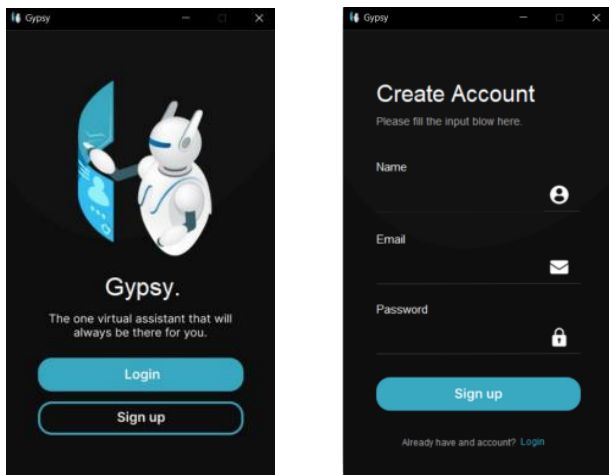


Figure 3: Welcome Screen and Signup Screen

Upon login, the user's credentials are verified against the MySQL database. Successful validation grants access to the system, while failure results in a prompt for re-entry of details. Within the system, it remains in a standby state until the receipt of a voice or text command. These commands are then processed—voice commands are converted into text, while text commands are channeled directly through the keyboard to the system settings.

Similarly, when tasked with a mathematical calculation through voice or text input, the system identifies the operation type and returns the precise result.

During operation, the system interfaces with the Internet and the operating system to access APIs

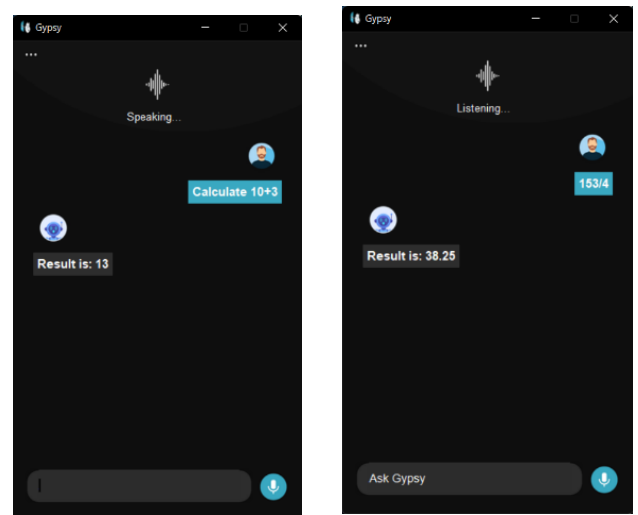


Figure 5: Calculation through text or voice command

In another scenario, when prompted with "news," the system inquires whether the user seeks local or international updates, subsequently displaying news accordingly

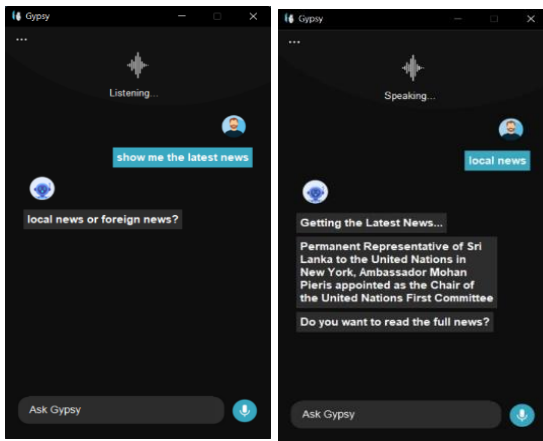


Figure 6: Showing latest local and foreign news

The study concludes with a comparative table showcasing functionalities across various virtual assistants, including the "Gypsy" project. This table underscores the "Gypsy" project's comprehensive capabilities in areas such as chatbot integration, web searching, emailing, messaging, navigation, translation, weather forecasting, predictive responses, and online order processing.

The encompassing functionality of the "Gypsy" project positions it with a considerably wider scope of operations when contrasted with other virtual assistants in the market.

Functions	Chatbot	Open Apps	Web Search	Send Email	Send Whatsapp message	Get Direction	Translate	Weather Forecast	Response using a Trained Predictive Dataset	Online Order Items
Research Projects										
Google Assistant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Apple Siri	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Microsoft Cortana	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Virtual Personal Assistant	No	Yes	Yes	Yes	No	No	No	Yes	No	No
Smart Voice-Based Virtual Personal Assistants	No	Yes	Yes	No	No	Yes	No	Yes	No	No
Voice-Enabled Personal Assistant for PC	No	No	Yes	No	No	Yes	No	Yes	No	No
Voice Assistant using python and AI	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
"Gypsy" Project	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 7: Comparison between similar projects

CONCLUSION

Developed using the Python programming language, this system incorporates advanced technologies such as artificial intelligence, natural language processing, speech recognition, context-aware computing, deep learning, and more. The proposed system offers numerous advantages to users, including features like online ordering, access to desktop and web applications, web searches, reminder creation, live directions, note reading, weather forecasts, language translation, mathematical calculations, alarm setting, news updates, and messaging via emails and WhatsApp. It stands out for its superior efficiency compared to other virtual assistant software in the market. By utilizing this voice- and text-enabled virtual assistant, users can achieve more effective and time-saving computer interactions. The system delivers an engaging user experience without any associated costs, eliminating the need for typing and allowing users to operate their computer solely through voice commands.

RECOMMENDATIONS

As a future development process of this project, It is also intended to find Sinhala language terms and build the complete system through this method. As a result, even someone with limited understanding of the English language can use this virtual assistant software in their native tongue. The main problem in the future will be to design this system can communicate with associated hardware devices through WiFi or Bluetooth. Furthermore, it is intended to develop an AI-based virtual assistant software with comparable functionality that can be easily installed by Android phone users. As a result, people may acquire the assistance of a virtual assistant using only their smartphone.

ACKNOWLEDGMENT

We extend our sincere gratitude to Ms. Suranji Nadeeshani, a Senior Lecturer in the Department of Information Technology at the Faculty of Engineering and Technology, CINEC Campus, for her invaluable guidance and support throughout this project. Additionally, we would like to express our appreciation to Mr. Bhanuka Fernando and Ms. Sachini Vindya Gunasekara, both esteemed Lecturers in the Department of Information Technology at the Faculty of Engineering and Technology, CINEC Campus, for their valuable

assistance and contributions. Their expertise and unwavering support have greatly enriched the outcome of this project. We also want to thank all of our friends, coworkers, and family for their help.

REFERENCES

1. A. N. R. Augustian Isaac, "Virtual Personal Assistant," *Journal of Network Communications and Emerging Technologies (JNCET)*, vol. 8, no. 10, pp. 29-31, October (2018).
2. S. P. G. R. D. Sampad Mondal, "Virtual Personal Assistant with Face Recognition Login System Using Machine Learning and Artificial Intelligence," *International Journal of Engineering Science and Computing*, vol. 9, no. 4, pp. 21603-21605, 2019.
3. A. R. D. S. A. S. A. E. M. Vasudha Vashisht, "Perceptive Personal Voice Assistant," *Ijrasnet Journal For Research in Applied Science and Engineering Technology*, 2022-04-25.
4. C. K. G. S. V. K. Geetha v., "The Voice Enabled Personal Assistant for Pc using Python," *International Journal of Engineering and Advanced Technology*, vol. 10, no. 4, pp. 162-165, 2021.
5. A. A. D. S. D. S. R. Divisha Pandey, "Voice Assistant Using Python and AI," *International Research Journal of Engineering and Technology (IRJET)*, vol. 9, no. 5, pp. 832-838, May 2022.
6. G. B. V. Kepuska, "Next-generation of virtual personal assistants (Microsoft Cortana, Apple Siri, Amazon Alexa and Google Home)," in *IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC)*, 2018.
7. N. L. Board, "National Lotteries Board," 2022. [Online]. Available: <https://www.nlb.lk/English/about/history>. [Accessed 12 July 2022].
8. K. A. Perera, "Demand for state lotteries in post war period: a case study from Ampara district in Sri Lanka," in *1st International Symposium 2011 on Post-War Economic Development through Science, Technology and Management*, South Eastern University of Sri Lanka, 2011.
9. P. J. C. C. T. Clotfelter, "Lotteries in the real world," *Risk Uncertain*, vol. 4, pp. 227-232, 1991.
10. C. Horner, "Sri Lanka lottery struggling to recover post-pandemic," 19 November 2021. [Online]. Available: <https://lotterydaily.com/2021/11/19/news/sri-lanka-lottery-struggling-to-recover-post-pandemic/>. [Accessed 01 August 2022].
11. David, "HISTORY OF THE LOTTERY," 31 May 2017. [Online]. Available: <https://www.lottoland.co.uk/magazine/history-of-the-lottery.html>. [Accessed 16 July 2022].
12. D. Y. & W. Liao, "Design of a Blockchain-Based Lottery System for Smart Cities Applications," *IEEE*, pp. 275-282, 2017.
13. H. L. & L. H. Liu Y., "Using an efficient hash chain and delaying function to improve an e-lottery scheme," *International Journal of Computer Mathematics*, vol. 7, no. 84, pp. 967-970, 2007.
14. R. L. M. S. C. Genest, "Chi-square and the Lottery," *Mathematics*, pp. 1-19, 2001.
15. R. C. J. L. Zhifeng Jia, "DeLottery: A Novel Decentralized Lottery System Based on Blockchain Technology," *Distributed, Parallel, and Cluster Computing*, pp. 1-6, 06 November 2019.
16. Y. A. F. Z. K. & Y. J. Zhang, "A Verifiable E-Lottery Scheme," in *Machine Learning for Cyber Security: Third International Conference, China, 2020*.
17. A. HAYES, "Chi-Square (χ^2) Statistic," 22 August 2022. [Online]. Available: <https://www.investopedia.com/terms/c/chi-square-statistic.asp>. [Accessed 30 August 2022].
18. H. Joe, "Tests of uniformity for sets of lotto numbers," *Statistics & Probability Letters*, vol. 16, pp. 181-188, 1993.
19. V. L. P. S. Y. C. S. . M. Y. Elisavet Konstantinou, "Electronic National Lotteries," in *International Conference on Financial Cryptography*, 2004.

Original Article

Preliminary Study on Evaluation of Knowledge, Attitudes and Practices (KAP) of Pharmacy Workers on Generic Vs. Branded Medicine in Colombo District, Sri Lanka

Dharmapriya H.A.T¹, Nikathenna H.M.L.S¹, Jayasiri T.P.K², Mendis D.H.A², Ratnayake W.M.K.M¹

¹*Department of Cosmetic Science, Faculty of Health Sciences, CINEC Campus, Sri Lanka*

²*Department of Pharmacy and Pharmaceutical Sciences, Faculty of Health Sciences, CINEC Campus, Sri Lanka*
kalpani.ratnayake@cinec.edu

ABSTRACT

Pharmacists, apprentice pharmacists and non-pharmacists belong to the same umbrella of pharmacy workers as they all work in a pharmacy. They perform a wide range of tasks within the pharmacy. In addition to ensuring that the medications patients are prescribed are appropriate, speciality pharmacists also help patients with concerns and provide advice on how to take their medications and potential side effects. Therefore, pharmacy employees must have the right knowledge, attitudes, and behaviours for a pharmacy to run well and to provide the right medication along with the right guidance. This study aimed to investigate pharmacy workers' knowledge, attitudes and practices (KAP) in the Colombo district. A descriptive cross-sectional study was performed among pharmacy workers in the Colombo district, including pharmacists and non-pharmacists, using a structured questionnaire. The ethical clearance was obtained from the Ethics Review Committee, CINEC Campus. Out of 100 participants, 15% were pharmacists, 37% were assistant pharmacists and 48% were pharmacy-supporting workers. Among the participants, 60% agreed with substituting generics for branded medicines in all cases where a generic is available. While 14% disagreed with that, 26% were neutral. However, 61% believed some medicine brands are more effective, and 6% disagreed. Among participants, 33% mentioned that sometimes they believe some brands are more effective. Further, 5% of participants always dispense other brands in addition to the brand which the doctor has prescribed. While 89% are only dispensed to other brands when the prescribed brand is unavailable, 6% have never done so. Out of the 5% of participants who always dispense other brands

20% are pharmacists and 80% are non-pharmacists. Also, 93% of participants usually inform the patients when they change the brand, and 7% are not informed. According to the results, some workers still needed to have adequate KAP regarding generic and brand of drugs. Hence, it is concluded that some healthcare workers at pharmacies require further improvement based on KAP.

Index Terms- *Apprentice pharmacists, Pharmacists, Branded Medicine, Generic*

INTRODUCTION

Colombo District, Sri Lanka, has a vibrant pharmaceutical scene that serves the varied healthcare needs of its residents by allowing branded and generic medications to coexist. Selecting between branded and generic pharmaceuticals is a crucial decision that is impacted by a variety of factors, including familiarity, perceived efficacy, and cost. The main goal of this study is to comprehend pharmacy employees' knowledge, attitudes and practices (KAP) about these drugs in this particular environment.

Pharmacy employees, who act as first-line intermediaries between patients and prescription drugs have more impact on getting the desired drug by consumers or patients. People looking for healthcare solutions choose medications largely based on their observations and activities. The influence on good prescription and dispensation patterns dissects their knowledge, attitudes, and operational practices regarding generic and branded drugs.

Pharmacy workers must adhere to established treatment guidelines, to ensure that patients comprehend the purpose of their prescribed medications (generic or branded), any potential side effects, interactions with other medications, and the proper way to take their medication and ensure that the recommended treatment regimen is as straightforward as possible. To prevent issues, the patient should be informed of the rationale and benefits of moving to a generic drug if they are unable to afford the branded one. The true cost of the drugs and the effects of getting to a generic version may be more effectively taken into consideration.

In 2017, Straka *et al.* [1] state that, when it is medically justified, doctors and patients should be permitted to request the branded product in specific therapeutic areas. Each patient should have their own decisions about getting generic medications, together with information about any potential negative effects. The transition and evaluation of its overall effects need proper monitoring and good general education regarding the medicines available for purchase [1].

In some countries, switching to a different prescription source is a recommended practice to lower healthcare expenditures. However, when narrow therapeutic index medications are administered, care should be used. If bioequivalence is demonstrated, switching from brand to generic is a feasible course of action. Certain drugs, such as those with a narrow therapeutic index, critical dose, or significant variability, need to be monitored with great care as they cannot be interchanged with innovative equivalents according to the preferences of patients or pharmacy workers [2].

Comparatively, to branded medications, generic drugs were perceived negatively in another study with participants reporting that they were less effective, inferior, and caused more side effects [3]. These data reveal that registered pharmacists worldwide, substitute generic medications for branded ones. Similarly, a different survey conducted among medical students revealed favourable opinions and understanding regarding the prescription of generic medications [4]. Adequate knowledge about some aspects of the

pharmacokinetics of generic medications needs to be improved among the pharmacy workers regarding the issue of generic drug cost and quality for a better health care service within a country [5].

It is more challenging for pharmacists to dispense certain drugs because of the abundance of branded generics that are available in the pharmacy. Throughout the procedure, they typically dispense goods regardless of quality that are sold at the highest profit margin. Most of the time unattractive packaging and unavailability of advertising activities contribute to the lower appeal of unbranded generics [6].

Moreover, many studies, emphasize the necessity of changing the policy regarding medicine prices, controlling markups in the generic supply chain, and conducting and widely publicizing quality testing of generics to raise awareness among all relevant parties [7].

Community pharmacists state that factors such as patient demand for the medication, manufacturer credibility, bonuses, and incentives affected how generic medications were stocked and dispensed in their establishments. Pharmacists had a favourable opinion of generic medications and substituting branded with generics. Educational intervention and continuing education training programs are necessary to enhance pharmacy workers' dispensing practices of generic medications. [8].

Hence, this investigation is important because these assessments yield, important information to improve drug availability, use, and overall health outcomes and the way of these behaviours and attitudes affect patients' views and compliance with recommended therapies is crucial. Additionally, this study lays the groundwork for future interventions and educational programs aimed at improving pharmacy employees' and customers' ability to make well-informed prescription decisions.

This study aimed to evaluate pharmacy employees' KAP about the generic vs. branded medications, in the Colombo area to evaluate the correct operation of a pharmacy.

METHODOLOGY

The Research study was a descriptive cross-sectional study. The study population was pharmacy workers working in the Colombo district, Sri Lanka, 20-60 years of age and given their consent to participate in the study and those free of any physical or mental disabilities that may hinder them from responding to the questionnaire. Participants who did not wish to provide data for the research and those who did not comply with the relevant admission recommendation were excluded. The pharmacy workers were divided into three categories, i.e. pharmacists, apprentice pharmacists and other pharmacy workers. The people who have registered at the Sri Lanka Medical Council (SLMC) with a registration number, was considered a pharmacist. The individual who applied for the pharmacist examination registration and following the training period was considered as an apprentice pharmacist. The individual who works in the pharmacy assists pharmacists and apprentice pharmacists in the proper functioning of the pharmacy but does not fulfil the minimum educational qualification to register as the apprentice pharmacist considered as other pharmacy workers.

The sample size was calculated by using a standard formula ($n = [Z^2 \times p(1-p)]/d^2$ where n = Sample size, Z = standard normal deviation for the chosen confidence level. Z will be 1.96 in confidence level 95%, p = expected proportion of the subjects with the characteristics and d = margin of error). The sample size in this preliminary study was 100 participants.

The Survey contained questions selected to assess the KAP toward using generic vs branded medicine. Survey data were collected from a convenience sample, using a self-administered questionnaire survey. Structured questionnaires with close-ended questions were used in the current study to gather information about respondents' KAP regarding generic vs branded medicine. A validated questionnaire was prepared as a Google form in three languages i.e. Sinhala, English and Tamil, and distributed through social media platforms openly inviting pharmacy workers in the Colombo district, Sri Lanka. Those

who had consent to participate in the study filled out the consent form and the questionnaire.

Ethical clearance for this study was obtained from the Ethics Review Committee of the CINEC Campus, Malabe, Sri Lanka (ERC No:ERC/CINEC/2021/009).

The questionnaire consisted of question categories belonging to socio-demographic characteristics and KAP belonging to generic vs branded medicine.

The data was analysed using SPSS version 26. Descriptive statistics, mean \pm SD, frequencies, and percentages were computed. Normality is assessed using graphical representations and Kolmogorov statistics. The continuous variables were compared using ANOVA and categorical variables using Chi-square statistics. $p < 0.05$ was significant.

RESULTS

The socio-demographic characteristics of the pharmacy workers in Colombo district, Sri Lanka are shown in Table 1. Among the participants, the majority were female (55%) and belonged to the age category of 20- 30 years (86 %).

Table 1: Socio-demographic characteristics of the pharmacy workers in Colombo district, Sri Lanka (N= 100).

Variable	Frequency (%)
Gender	
Male	45
Female	55
Age	
20-30 Years	86
31-40 Years	8
41-50 Years	3
51-60 Years	3
Highest Educational Qualification	
G. C. E. Ordinary Level (O/L)	0
G. C. E. Advanced Level (A/L)	56
Diploma	24
Degree	16
Postgraduate	4
Educational qualification related to the pharmacy or pharmaceutical field	
Yes	60
No	40
Employment position	
Pharmacist	15
Apprentice pharmacist	37
Other pharmacy worker	48
Duration of working experience	
Less than 1 year	54
1-3 years	35
3-5 years	4
5-10 years	4
More than 10 years	3
Continuous working hours	
Less than 2 hour	14
2 hours	17
2 - 5 hours	34
5 - 8 hours	19
More than 8 hours	16

The agreement for the statement of “Some medicine brands are more effective” is shown Figure 1.

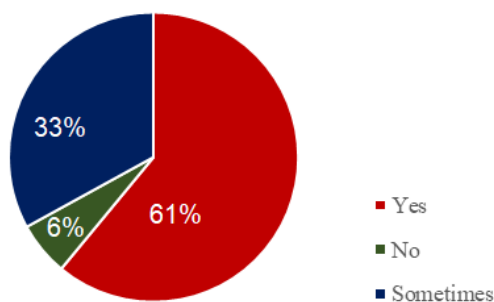


Figure 1: The agreement for the statement of “Some medicine brands are more effective”

Among the pharmacists, 66.67% agreed with the statement “Some medicine brands are more effective” and none of was disagreed. 33.33% of pharmacists mentioned some medicine brands are sometimes more effective. Among the apprentice pharmacists, 51.35% and 10.81% agreed and disagreed with the statement “Some medicine brands are more effective” respectively. However, 37.83% of apprentice pharmacists said it is true only at sometimes. Also, 66.67% of other pharmacy workers believed some medicine brands are more effective while 4.16% of them unbelieved it. Further 29.16% of other pharmacy workers agreed with the statement that some medicine brands are more effective only sometimes.

The study has evaluated the practice of pharmacy workers in substituting other brands in addition to the specific brand prescribed by a medical practitioner (Figure 2)

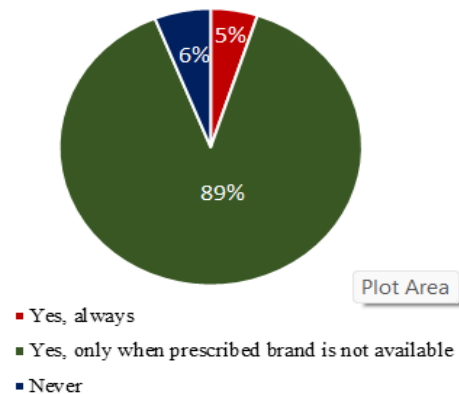


Figure 2: The agreement for the statement of “substituting other brands in addition to the specific brand prescribed by a medical practitioner”

In the Sri Lankan pharmacy system, only pharmacists have the authority to issue medicines to the patient according to the prescription delivered by a registered medical practitioner. Although apprentice pharmacists and other pharmacy workers do not directly issue medicine to a patient, they assist the pharmacist to put the drug. Hence, we evaluated the attitude and practices of all pharmacy workers regarding “substituting other brands in addition to the specific brand prescribed by a medical practitioner”.

Among the 5 % of the participants who always substitute the brands other than the brand prescribed by the medical practitioner 20% are pharmacists and 60% are apprentice pharmacists. The rest of 20% are other pharmacy workers. However, among the pharmacist participants of the research, 73.33% are substituting brands from another brand when only the prescribed brand is not available at the pharmacy. This is also done by 91.89% of apprentice pharmacists and 91.67% of other pharmacy workers. However, 20% and 0% of pharmacists and apprentice pharmacists never substitute brands other than to the brand on prescription, respectively. The study showed that 6.25% of other pharmacy workers also never substitute brands other than the prescription brand.

Also, among the participants, the majority agreed with substituting generics for branded medicines in all cases where a generic is available (Figure 3). Among the pharmacists, 53.33% agreed about substituting generics for branded medicines in all cases where a generic is available while 20% disagreed. However, 26.67% of pharmacists are neutral on this. Also, 56.76 % of apprentice pharmacists and 64.58% of other pharmacy workers agreed with substituting generics for branded medicines while 10.81% and 14.58% disagreed respectively. Further, 32.43% of apprentice pharmacists and 20.83% of other pharmacy workers were neutral on this statement.

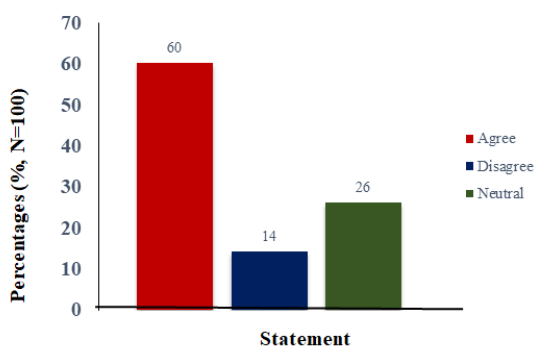


Figure 3: Generic substitution for branded medicine

To evaluate the practices related to selling of brands, in pharmacy workers in the Colombo district, Sri Lanka, the questionnaire consisted of a question “Do you inform the patients when you change the brand of the medicine?” Among the participants, majority responded “Yes” (Figure 4).

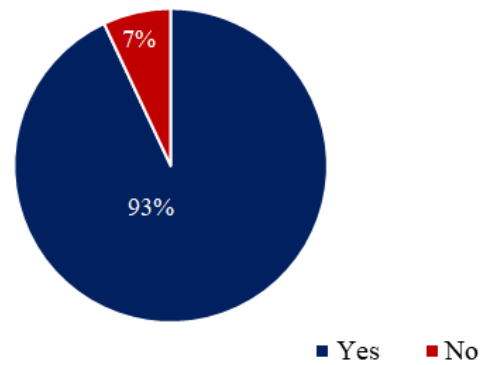


Figure 4: Inform the patients when changing the brand of the medicine

Among the 15% of pharmacists in the total participants of the study, 86.66% informed the patients when changing the brand of the medicine while 13.33% did not. Further, 97.29% of apprentice pharmacists and 91.66% of other pharmacy workers are informing the patients when changing the brand of the medicine. However, 2.70% of apprentice pharmacists and 8.33% of other pharmacy workers are not informing the patients when changing the brand of the medicine.

DISCUSSION

In the Sri Lankan aspect, the pharmacists, apprentice pharmacists and other pharmacy workers play an enormous role together in the healthcare sector. Retail pharmacists distribute prescription drugs to the general public and instruct clients on illness prevention, health promotion, and the correct use of medications. In addition to that they are responsible for selling non-prescription medications and associated items. Under the close supervision of a pharmacist, a pharmacy apprentice carries out the duties. When it comes to measuring, mixing, or labelling prescription drugs for consumers, pharmacy apprentice helps pharmacists prepare medicines. Although other pharmacy workers are not directly involved in dispensing medicine to a patient, they also assist pharmacists and pharmacy apprentices to make their duties. Hence, pharmacists, apprentice pharmacists and all other pharmacy workers play important roles in the smooth functioning of pharmacies and assessing their KAP regarding different factors which can affect their role will help to appropriate operation of the pharmacy as well as to develop awareness programmes in future. Because of that this study

aimed to evaluate pharmacy employees' KAP about the generic vs. branded medications, in the Colombo area.

Several previous studies have evaluated the knowledge and attitudes of pharmacists toward generic drugs internationally. According to a similar study conducted by Al-Arif [5], the majority (85%) supported generics over branded medicines in all cases where a generic is available. 60.4% of the participants had the attitude that pharmacists should be allowed to perform generic substitutions without consulting the prescribing physician while 48% agreed that they should consult physicians before prescribing generics to patients. That study reported that pharmacy students have a sufficient level of knowledge of generic medicines [5].

In many countries, the attitudes toward generic medicines are not positive as they believe that in some cases generic medicines do fail to give desirable results [9]. Previous studies reported that Saudis have negative beliefs about the quality and efficacy of generics and consumers' attitudes toward the high efficacy and safety of branded medicines [10]. A Yemen study among pharmacy students also revealed this same negative belief while another study among Pakistan healthcare students has given positive perceptions and knowledge about generic medicine [5].

According to a related study conducted in India, different experiences and preferences influence prescriber's decisions on generic and branded medicine. Although the pharmacist can decide on the brand when the prescriber writes only a generic name on a prescription, in most cases, doctors do not tend to prescribe the generic drug as they are not satisfied with the safety and effectiveness of generics compared to branded medicines [11].

The practice of generic substitution among registered pharmacists varies from country to country with their different laws. In Great Britain, it is not permitted whereas in Canada, all provinces except British Columbia allow this according to a regulated list. Without informing the consumer, pharmacists make some substitutions [9].

In selling medicines, generic drugs are not profitable as compared to branded medicines and therefore, this can be influential on the attitudes of pharmacists. In addition, less demand and lack of availability of generics has become a reason that generics are not popular in the Indian market [11].

However, to maintain their positive contribution, pharmacy workers must have a good KAP regarding the medicines that they dispense. With the ultimate aim of contributing to patient safety in the country, we have planned this research to investigate the current level of KAP toward Generic vs. branded medicines by pharmacy workers in the Colombo district.

Also, as this is a preliminary study with 100 pharmacy workers, we are expecting to continue this study to reach more pharmacy workers in the Colombo district and also to expand the study into other districts.

CONCLUSION

The results concluded that awareness an average lower level than expected. Even some pharmacy workers lacked knowledge and practices regarding Generic vs. branded medicines. The analyzed results confirmed that pharmacy workers are still violating the law, leading to profound malpractice in retail pharmacies.

Furthermore, these findings will be helpful for any authority to be concerned about the supervision given to new pharmacy workers and implement new rules and regulations as a part of a plan to uplift their knowledge and awareness.

DECLARATIONS

A. Study Limitation

This study was limited to 100 pharmacy workers in the Colombo district Sri Lanka. This was taken as a preliminary study and the study should continue to reach maximum sample size. Moreover, self-reported answers were vulnerable to biases and errors in reporting, which might lead to an overabundance or underabundance of information because of misinterpreted questions.

B. Acknowledgements

The authors would like to thank all participants who had volunteered for the study.

C. Funding source if any

None.

D. Conflict of Interests

No conflict of interest exists in this publication.

E. Ethical Approval

This study was reviewed and approved by the Ethics Review Committee of CINEC Campus, Malabe, Sri Lanka.

F. Informed Consent

Informed consent which was approved by the Ethics Review Committee of CINEC Campus, Malabe, Sri Lanka was shared with the participants before the questionnaire

REFERENCES

1. Straka RJ, Keohane DJ, Liu LZ. Potential clinical and economic impact of switching branded medications to generics. *American journal of therapeutics*. 2017;24(3):278.
2. Al-Jazairi AS, Blhareth S, Eqtefan IS, Al-Suwayeh SA. Brand and generic medications: Are they interchangeable? *Annals of Saudi Medicine*. 2008;28(1):33–41.
3. Othman GQ, Abdulghani MA. Assessment of knowledge and perceptions of generic medicines among pharmacy students in Yemeni universities. *Pharmacy Education*. 2015;22;15.
4. Asif U, Saleem Z, Yousaf M, Saeed H, Hashmi FK, Hassali MA. Exploring the knowledge and attitude of medical and pharmacy students about generic medicine in Lahore, Pakistan. *Journal of Generic Medicines: The Business Journal for the Generic Medicines Sector*. 2017;19;14(1):22–8.
5. Al-Arifi MN. Assessment of Knowledge, Attitudes, and Factors Influencing the Selection Student of Generic Medicine. *Frontiers in Public Health*. 2021;6;9.
6. Bhattacharyya NC. Generic versus branded medicines. *Int J Health Res Medico Leg Prae*. 2019;5(1):1-2.
7. Kotwani A, Singal G, Nanda A. A comparative evaluation of price and quality of some branded versus branded-generic medicines of the same manufacturer in India. *Indian Journal of Pharmacology [Internet]*. 2011;43(2):131.
8. Al-Saadi A, Haridass S, Nouri A. Knowledge, attitude, perception, and practices of generic substitution of community pharmacists in the north al-Batinah governorate of Oman: a pilot study. *Palestinian Medical and Pharmaceutical Journal*. 2023;8(2):15.
9. Igbinovia ME. *The perceived benefits of generic versus branded medicines* (Doctoral dissertation, University of Pretoria).
10. Albadr Y, Khan TM. Factors influencing community pharmacist decision to dispense generic or branded medicines; Eastern Province, Alahsa, Saudi Arabia. *Saudi Pharmaceutical Journal*. 2015;23(2):143–6.
11. Pillai A. A Comparative Evaluation of Cost and In-Vitro Study between Branded and Generic Medicine. *iMedPub Journals*. 2022;22;14.

Principles for Responsible Management Education (PRME) in Sri Lankan Business Schools: A Pathway to Sustainable Business Education

A Study of Curricular Integration, Stakeholder Engagement, and Sustainable Development Outcomes

Bishri R

UTS College Colombo Campus, Sri Lanka

Rizna.Bishri@insearch.edu.lk

ABSTRACT

This research study is an analysis of the introduction and application, PRME within Sri Lankan business schools to promote a sustainable management education. This study applies an integrated approach through analyzing diverse facets of PRME implementation issues comprising alignment curriculum component, stakeholder involvement and realization to sustainable development benefits.

By using a mixed-methods research design, the study assesses systematically the problems and respond encounters in integration of PRME criteria to curriculums offered by Sri Lankan business schools identifying activities which impact this process. Furthermore, the research analyses stakeholder engagement in PRME implementation path with a focus on collaboration between businesses, government agencies and civil society organizations that promotes achievement of sustainable development outcomes.

The outcomes of this study offer not only a profound picture of the current situation with regards to PRME adoption but also shed fantastic light on its development prospects and influence over Sri Lankan business schools. This study pinpoints successful strategies thus it helps in developing a sound sustainable business education pathway for Sri Lanka.

Index Terms- Principles For Responsible Management Education, Sustainable Business Education, Curricular Integration, Stakeholder Engagement, Sri Lankan Business Schools, Sustainable Development Outcomes

INTRODUCTION

A. Background and Significance of the Research

It is therefore no surprise that the worldwide adoption of Principles for Responsible Management Education (PRME) framework to form a guiding beacon which signals vigorously on ethics, sustainability and responsible leadership aspects in today's business school educational curricula [24]. The efforts of PRME to be globalized and their active engagement in Sri Lankan business schools is still a lesser-explored terrain. The need for the infusion of business education with codes and tenets must be argued not to be discardable in a country like Sri Lanka where Business is seen as an integral cog mechanism needed successful economic adventures both micro level at individual levels, macro levels through media agencies such states.

Sri Lanka with its well-recognized business community is set to gain immensely from the adoption or inclusion of PRME in her Business Education System. The country's aspirations for sustainable economic development combined with ethical business activities are in tandem to the PRME principles, which consist of values such as ethics, sustainability and social responsibility [22]. However, the developmental process is anything but without its problems including issues with curriculum alignment to name a few.

B. Research Questions

This research endeavors to explore, assess, and understand the impact of implementing of PRME in Sri Lankan business schools by addressing the following questions:

1. How is PRME currently integrated into the curriculum of Sri Lankan business schools?
2. What are the challenges and opportunities associated with PRME in curricular integration?

3. What role does stakeholder engagement play in the implementation of PRME, and how does it influence sustainable development outcomes?
4. What are the measurable outcomes and impacts of responsible management education in the Sri Lankan context?

C. Research Objectives

The primary objectives of this research are as follows:

1. To evaluate the current state of PRME implementation in Sri Lankan business schools.
2. To identify the challenges and opportunities related to the integration of PRME principles into the curriculum.
3. To assess the significance of stakeholder engagement in the context of responsible management education.
4. To measure the impact of PRME on sustainable development outcomes in Sri Lanka.

LITERATURE REVIEW

A. Understanding PRME

The UN initiative of the Principles for Responsible Management Education (PRME) Program developed in 2007 describes a paradigm shift in vocational education, responding to worldwide challenges—climate change inequality and social foundations. PRME demands that business schools embed responsible management and sustainability in the core of their activities [22] which invokes ecological, ethical as well as sociocultural dimensions within overall education frameworks. Aligned with the United Nations Global Compact's mission, PRME aims to encourage businesses to adopt sustainable practices [22]. In Sri Lanka, several business schools are increasingly adopting PRME principles to prepare future leaders with a foundation in responsible management, meeting the ethical and sustainable demands of the business world [11].

B. Principles of PRME

PRME is grounded in six key principles that guide business schools and universities in integrating responsible management and sustainability into their curricula and practices [22]:

1) *Purpose*: Institutions are encouraged to develop educational programs that not only equip students

with business knowledge but also instill a sense of purpose that extends beyond profit, emphasizing ethical values and societal impact [22].

2) *Values*: PRME underscores the importance of fostering values such as integrity, transparency, and social responsibility within the educational environment, promoting ethical behavior among future business leaders [22].

3) *Method*: The initiative advocates for the incorporation of responsible management principles into teaching methods and pedagogical approaches, engaging students in critical thinking about sustainability and ethical dilemmas [22].

4) *Research*: PRME encourages research that contributes to the understanding of responsible management and sustainability issues, fostering a knowledge base for informed decision-making in business and society [22].

5) *Partnership*: Collaboration with businesses and other stakeholders is a fundamental principle of PRME, emphasizing the importance of real-world engagement to bridge the gap between theory and practice [22].

6) *Dialogue*: Finally, PRME promotes an open and continuous dialogue within and outside academic institutions, facilitating discussions on responsible management education and encouraging innovation in this field [22].

C. Global Adoption of PRME

PRME's adoption has indeed been extensive, reflecting its resonance with the evolving needs of business education worldwide. As of 2021, more than 800 institutions from over 85 countries have become signatories to PRME, marking a remarkable level of global participation [18]. The reasons for this wide-scale adoption are multifaceted and underscore the recognition of PRME's significance:

1) *Relevance to Contemporary Challenges*: The concerns of our time are climate change, social inequality and business misconduct in terms of lack of ethics which PRME targets. Business schools are becoming much better at taking into consideration that they themselves play a part in developing future leaders, capable of addressing those challenges [23].

2) *Student and Stakeholder Demand*: Both students, faculty and stakeholders in the Business community are getting louder about responsible management education [18]. PRME adoption can attract them as powerful incentive for these individuals educational and socialistic values oriented.

3) *Global Network and Collaboration*: PRME builds a global network of institutions pursuing responsible management education. In this cooperative space, good practice and innovative thinking about embedding sustainability in curricula are freely presented [25].

4) *Corporate Expectations*: Organizations around the world have come to appreciate responsible management as a strategy leading to a positive reputation, reduction of risk and long-term profitability. Since firms look for graduates with a sound understanding of ethical and sustainable business practices, institutes providing managerial education have thus responded accordingly [24].

5) *Accreditation and Rankings*: Some accrediting bodies and rankings systems have started to incorporate responsible management education criteria. As a result, institutions are motivated to align with PRME to maintain their competitiveness and reputation in the education sector [8].

D. Evolution of Business Education in Sri Lanka

It has been through a fair number of changes over the last decades, in vocational education sector in Sri Lanka. Traditional classes based on entrepreneurial theories dominated the field of teacher education historian; few concerns were ethical, environmental and social issues [1][2]. Nevertheless, in response to global trends and students' demand benefits as well for the business community responsive management education was perceived by Sri Lanka Business institutions [10].

E. Recognition of Responsible Management Education in Sri Lanka

Business education landscape situation in Sri Lanka has dramatically changed over time. Increasingly, business schools and management institutions in the country acknowledge the significance of responsible education. PRME integration into business education will also benefit Sri Lanka because of the growing economy and business circle [11]. Nevertheless, PRME adoption confronts Sri Lanka with certain challenges and opportunities. Such challenges may be integrating PRME principles into the current curriculum, faculty development and developing a sense of responsible management environment in institutions [10].

Considering the burgeoning economy, promising business setting and fast-growing business

community of Sri Lanka; in a nutshell this country is well-capable to avail substantial benefits from integration of PRME principles into its mainstream Business Education Sector. This recognition is underscored by several factors:

1) *Global Relevance*: The global relevance of PRME principles aligns with Sri Lanka's aspirations to integrate with international business practices and standards. PRME provides a framework for aligning Sri Lankan business education with global best practices [22].

2) *Industry Needs*: Sri Lanka's growing economy has generated an increased demand for ethical, socially responsible, and sustainable business practices. Local businesses are recognizing the advantages of responsible management, and they seek graduates who can contribute to these goals [22].

3) *Student Demand*: Students in Sri Lanka are increasingly aware of the importance of ethical and sustainable business practices. They are actively seeking educational institutions that offer responsible management education, creating a demand that institutions are keen to meet [11].

F. Challenges and Opportunities in Adopting PRME in Sri Lanka

The adoption of PRME principles in Sri Lanka presents the following for consideration.

Challenges:

1) *Curricular Alignment*: Integrating PRME into curricula demands thorough review and modification, emphasizing ethical, environmental, and social dimensions, requiring curriculum development and faculty training [16].

2) *Faculty Capacity*: Curricular integration faces resource limitations, resistance to change, and the necessity for faculty development [13]. Finding suitable resources and materials is a challenge [11]. Faculty capacity building through development programs is vital for effective PRME-aligned education delivery.

3) *Cultural Shift*: Fostering responsible management entails curricular and institutional shifts to prioritize ethics and sustainability in practices and policies.

Opportunities:

1) *Business Engagement:* Sri Lankan businesses have shown increasing interest in collaborating with educational institutions to promote responsible management. These collaborations can provide resources, real-world insights, and opportunities for experiential learning [11].

2) *Global Networking:* Becoming part of the global PRME network offers opportunities for knowledge exchange and collaboration with international institutions that have successfully integrated responsible management education.

3) *Competitive Advantage:* Institutions that successfully adopt PRME principles can position themselves as leaders in responsible management education, attracting students and faculty who are passionate about sustainability and ethics.

G. Stakeholder Engagement in Education

Stakeholder networks Organizations, including corporations, government agencies, civil society organizations and graduates, are actively involved in educational policy and decision-making in academic institutions [20]. In the perspective of PRME, effective stakeholder engagement is considered a cornerstone for successful implementation.

H. The Role of Stakeholders in PRME

Involvement of stakeholders therefore lies at the core of successful incorporation and application of the PRME framework. Stakeholders include teachers, students, employees, businesses organizations and civil society organizations. These actors play a critical role in determining the nature which responsible management education takes [14]. Furthermore, the major function of stakeholders in PRME involves collaboration, advocacy and support for activities related to responsible management education. Their interests reach beyond the classroom and affect curriculum development, research agendas, outreach activities [19].

I. Collaborations with Businesses, Government, and Civil Society

Effective collaboration with various stakeholders brings diverse perspectives and resources to the table to create success of PRME initiatives.

1) *Businesses:* Collaborations with businesses can involve guest lectures, internships, and research partnerships. These engagements provide students

with real-world insights and opportunities to apply responsible management principles in practical settings. Additionally, businesses can contribute financially and strategically to the development of PRME-related programs [14].

2) *Government:* Government bodies can support PRME by aligning educational policies with responsible management education objectives. They can also facilitate partnerships between business schools and industry stakeholders, promoting ethical and sustainable business practices through regulatory frameworks [19].

3) *Civil Society:* Civil society organizations can serve as advocates for responsible management education, promoting awareness and accountability. They can engage with business schools in sustainability-focused projects, further enhancing the integration of PRME principles into curricula [14].

J. Assessing Stakeholder Impact

Assessing stakeholder engagement in PRME is vital for evaluating responsible management education. It involves analyzing contributions and outcomes through surveys, interviews, and program assessments. This feedback guides improvements, ensuring PRME initiatives align with stakeholder needs, enhancing their effectiveness and responsiveness to evolving expectations [14].

K. Faculty and Student Perceptions

Obtaining favorable perceptions of both the faculty and students is crucial for effective PRME implementation. In terms of PRME related stakeholders, the key ones are faculty members who teach directly amidst content concerned. Their buy-in and enthusiasm for responsible management education are crucial for effective integration [17]. Faculty members' perceptions regarding the relevance and importance of PRME principles can impact the depth and quality of curricular integration. Similarly, student perceptions influence the success of PRME implementation. Students' understanding of the importance of ethical and sustainable practices in management can shape their engagement with PRME-related coursework and extracurricular activities [19].

L. Significance of Stakeholder Engagement in PRME Implementation

1) *Valuable Insights and Resources:* Through involving different actors, the learning process is made more valuable by offering one interesting views

of industry dynamics at this time which cannot be achieved through using solitary perspectives only. Institutions can use these insights to reformulate their curricula as c veterans' needs [14].

2) *Enhanced Relevance*: Collaboration with stakeholders ensures that business education remains relevant. As business practices evolve, stakeholders can offer guidance on the skills and knowledge graduates should possess to succeed in the job market [14].

3) *Support and Partnerships*: Stakeholder networks can lead to engagement and support from businesses and organizations. This collaboration can take a variety of forms, including internships, research projects, and financial contributions, all of which enhance the educational experience [14].

4) *Fostering a Responsible Business Ecosystem*: PRME's mission goes beyond individual education; it aims to create a responsible business ecosystem. Stakeholder engagement contributes to this mission by encouraging responsible practices not only within educational institutions but also within the broader business community [19].

M. Role of Stakeholder Engagement in PRME

In the context of PRME, stakeholder engagement plays a multifaceted role:

1) *Curriculum Development*: Stakeholders can offer input on the ethical, environmental, and social dimensions that should be integrated into curricula. This input ensures that graduates are well-prepared to address responsible management challenges [14].

2) *Experiential Learning*: Collaborations with businesses and organizations can provide students with opportunities for experiential learning, internships, and real-world problem-solving, reinforcing responsible management principles [14].

3) *Advocacy for Responsible Practices*: Engaged stakeholders can become advocates for responsible management practices in the business community, influencing policies, and fostering a culture of sustainability and ethics [19].

4) *Continuous Improvement*: Regular feedback from stakeholders allows institutions to continuously improve their responsible management education initiatives, ensuring they remain aligned with evolving expectations and needs [14].

N. Barriers to Implementation

1) Institutional Resistance

Resistance to Change: Resistance to implementing PRME in Sri Lankan Business Schools is a major hurdle. This may tend to impede education along the way as faculty members, administrators and even leaders within such institutions are most likely to be unwilling towards serious changes of trends in approach plus priorities [16]. A study by Murray et al. [16] highlights that resistance to change within educational institutions can be a substantial impediment to the adoption of responsible management education initiatives like PRME.

2) Financial Constraints

Limited Resources: Financial limitations can hinder the development and implementation of PRME-related initiatives. Acquiring teaching materials, designing new courses, and supporting faculty and staff training all require financial resources that may be scarce in some institutions [19]. Rasche and Gilbert [19] emphasize that financial constraints can challenge the integration of PRME principles into business education due to the costs associated with curriculum development and faculty training.

3) Faculty Development

Training Needs: Implementing PRME effectively often requires faculty and staff to undergo training and professional development to understand and incorporate responsible management principles into their teaching and research [19]. Faculty members may need workshops and resources to develop the skills and knowledge necessary for integrating PRME principles into their courses and research activities.

O. Significance of Barriers

1) *Resource Allocation*: Institutions must reconsider resource allocation, reprioritizing funds for PRME integration, including curriculum development, faculty training, and new teaching materials [16].

2) *Change Management*: To overcome resistance, employ change management tactics: engage stakeholders, communicate PRME benefits, and offer support and incentives for faculty involvement [15].

3) *Advocacy and Collaboration*: External partnerships alleviate budget constraints and offer resources for PRME. Collaborating with industry, government, and civil society benefits financially and educationally [19].

P. Sustainable Development Outcomes in Responsible Management Education

Sustainable development outcomes refer to the long-term effects and impacts of responsible management

education on students and society [13]. These outcomes encompass changes in student values, knowledge, behavior, and practices that contribute to the advancement of sustainability and responsible leadership.

Q. Measuring Impact: The Significance of Sustainable Development Outcomes

Measuring the impact of responsible management education is challenging but it is essential to evaluate the effectiveness of initiatives like PRME. Sustainable development outcomes serve as key indicators in this assessment, and their significance lies in several aspects:

1) *Holistic Assessment*: Sustainable development outcomes provide a holistic view of the influence of responsible management education. They go beyond quantitative metrics like employment rates and salaries to assess the broader societal and environmental impact of graduates [20].

2) *Alignment with PRME Goals*: The key vision and mission of PRME involves developing sustainability along with promotion for the value towards education that brings about responsible leadership. These assessments, concerned with the outcomes of sustainable development and based on graduates' readiness to address global challenges are former identified straightly with this mission because they measure what is proportional for how well preparedness among these accomplices. [20].

3) *Ethical Consciousness*: Studies have also indicated that responsible leadership education causes ethical consciousness and moral awakening to graduate leaders [12]. Measuring ethical consciousness among students and tracking its development over time is a crucial sustainable development outcome.

4) *Behavioral Change*: Lastly, sustainable development outcomes also incorporate behavioral and practice modifications by graduates. Some of the changes that may occur are bringing sustainable business practices, corporate social responsibility and involvement in causes such as socially responsible investing [12].

R. Positive Sustainable Development Outcomes

Research and empirical evidence have highlighted several positive sustainable development outcomes associated with responsible management education:

1) *Ethical Awareness*: Responsible management education has been shown to enhance students'

ethical awareness and commitment to ethical decision-making [12].

2) *Global Perspective*: Graduates often develop a broader global perspective, understanding the interconnectedness of economic, social, and environmental issues [12].

3) *Problem-Solving Skills*: Problem-solving skills formed by responsible management education are necessary to address such formidable global challenges as poverty, hunger or environmental degradation [12].

4) *Responsible Leadership*: Graduates are thus better equipped to take up leadership positions that champion ethics, sustainability and giving back to society [12].

RESEARCH METHODOLOGY

A. Research Design: Mixed-Methods Approach

The contextualization of PRME implementation in Sri Lankan Business Schools demanded a mixed-methods research approach to capture the dynamics comprehensively. There is a mix of qualitative and quantitative methods involved in this study that has integrated and increased the depth of quality research questions [3].

B. Qualitative Methods: Semi Structured Interviews and Content Analysis

1) *Interviews*: Several semi-structured interviews occurred, with a pool of individuals that represented the stakeholders including faculty members, student administrators among others drawn from external organizations. These interviews give an insight into the challenges and opportunities for integration of PRME philosophy in schools on a more advanced level, thus inviting further study to reveal their intricate views [2]. Interviews with faculty members and administrators can uncover their motivations, challenges, and experiences in aligning curricula with PRME principles [1].

2) *Content Analysis*: Content analysis of documents, reports, and educational materials can provide a structured and systematic way to assess the extent to which PRME principles have been integrated into business school activities [9]. Content analysis can be used to evaluate the inclusion of ethical, environmental, and social content in course materials and institutional policies.

C. Quantitative Methods: Surveys

1) *Surveys*: Surveys can reach a larger sample of stakeholders, enabling generalizability to a certain extent [3][4]. A structured questionnaire was designed to gather quantitative data from stakeholders within Sri Lankan business schools. This survey was distributed to educators, students, administrators, and external partners involved in PRME implementation. The survey questions covered topics related to curricular integration, stakeholder engagement, and sustainable development outcomes, aligning with the research questions. Surveys distributed to students, alumni, and industry partners can quantify their perceptions of the impact of PRME on their knowledge, values, and practices [6].

D. Sample Selection and Size

The selection of participants for surveys and interviews followed a purposive sampling approach to ensure the inclusion of a diverse range of individuals from various Sri Lankan business schools. This approach was guided by factors such as the type of institution (public or private), geographical location, and the extent of PRME integration within these institutions. The respondents were selected from 2 public universities and 2 private universities whose names will be kept confidential on their request.

1) *Survey Sample Size*: The survey component of the research employed a sample size of 100 respondents. This size is often considered adequate for obtaining a meaningful representation of views and opinions, especially in qualitative research [7].

2) *Interview Sample Size*: For in-depth interviews, a sample of 20 respondents were chosen. This size allows for comprehensive exploration of individual experiences and perspectives, ensuring that the research captures nuanced insights [7].

DATA ANALYSIS AND DISCUSSION

The survey data revealed a spectrum of PRME integration levels within Sri Lankan business schools.

A) Integration of PRME in Curriculum

The survey findings reveal varying levels of PRME integration within Sri Lankan business school curricula. Notably, 20% of respondents indicated full integration, showcasing substantial efforts in incorporating PRME principles. A

significant majority (40%) reported significant integration, highlighting widespread recognition of PRME's importance. However, 30% found PRME somewhat integrated, suggesting potential for further development (Figure 1).

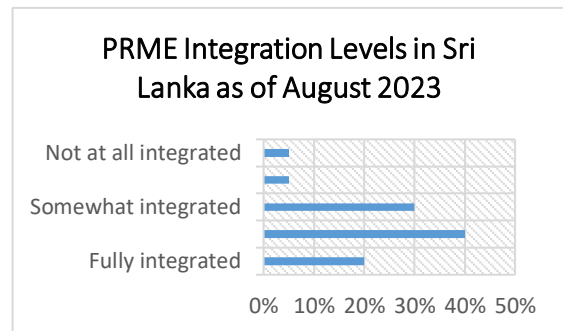


Figure 1: PRME Integration Levels in Sri Lanka as of August 2023

B) Challenges for integration

1) *Faculty Resistance*: One of the prominent challenges identified in the open-ended responses was "Faculty Resistance." This theme suggests that some educators may be hesitant to embrace PRME principles fully stemming from a variety of factors, including unfamiliarity with PRME, traditional teaching methods, or concerns about increased workload.

2) *Resource Constraints*: Integrating PRME often requires the allocation of additional resources for curriculum development, faculty training, and materials. Limited budgets and competing priorities can hinder the allocation of resources to support PRME initiatives.

3) *Lack of Materials*: The challenge is that faculty may encounter difficulties in finding or developing appropriate resources to teach responsible management effectively. The absence of readily available materials could slow down the integration process and place additional burdens on educators.

C. Opportunities to capitalize on

1) *External Collaboration*: Through collaborating with an external stakeholder, such as businesses organizations and government agencies the curriculum of a PRME institution can be enriched by including real-world perspective and expertise either through case studies or even guest lectures/practical experiences.

2) *Faculty Training*: The participants highlighted that the training of faculty and staff is essential for increasing their knowledge about PRME principles, teaching methodology etc. Equipping educators with the necessary knowledge and skills can empower them to integrate PRME effectively into their courses.

D. Active Engagement with External Stakeholders
The survey revealed widespread external stakeholder engagement in PRME implementation among business schools. Sixty percent of respondents reported active involvement with external stakeholders, indicating a proactive approach to collaboration, input, and involvement to improve responsible management education.

E. Impact of Stakeholder Engagement

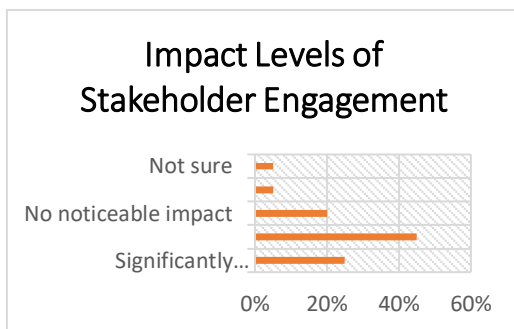


Figure 2: Impact Levels of Stakeholder Engagement in Sri Lanka

The survey highlighted the importance of stakeholder engagement in PRME implementation, categorizing responses into five impact levels. A significant portion (25%) noted that stakeholder engagement significantly enhanced PRME integration, positively influencing responsible management principles in the curriculum. The largest segment (45%) mentioned that stakeholder engagement somewhat enhanced PRME implementation, albeit to a lesser degree. However, 20% observed no noticeable impact from stakeholder engagement efforts (Figure 2).

F. Impact on Ethical Consciousness

The survey analyzed the perceived impact of PRME on students' ethical consciousness, categorized into five levels. Thirty-five percent believed PRME significantly enhanced students' ethical awareness, noting substantial improvement while 5% noted a negative impact on students' ethical consciousness (Figure 3).

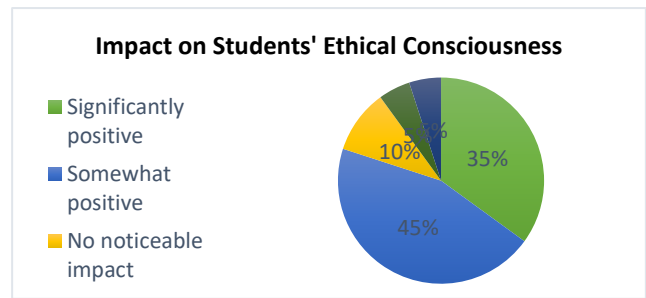


Figure 3: Impact on students' ethical consciousness

G. Behaviour Changes due to PRME implementation in Sri Lankan Business schools

The survey findings indicated a significant impact of PRME on the behavior of students, faculty, or staff in Sri Lankan business schools. Fifty-five percent of respondents observed changes related to sustainability and responsible management due to PRME implementation, highlighting noticeable shifts attributed to PRME initiatives (Figure 4).

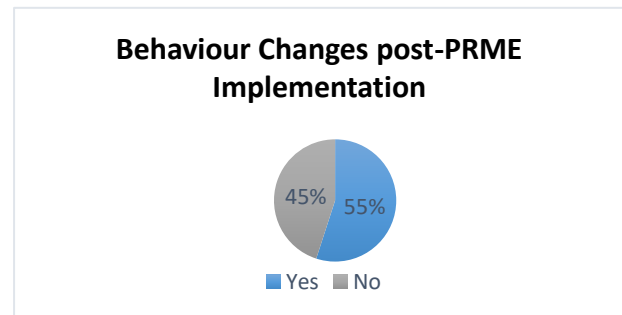


Figure 4: Behaviour changes post-PRME implementation

H. Key Measurable Outcomes to PRME in Sri Lankan Business Schools

Table 1: Key Measurable Outcomes post-PRME implementation

Measurable Outcomes	Percentage of Respondents
Increased Sustainability Initiatives	40%
Ethical Decision-Making	30%
Community Engagement	20%
Other (please specify)	10%

The data analyzed outcomes of PRME implementation in Sri Lankan business schools, with "Increased Sustainability Initiatives" cited by 40% of respondents indicating its role in fostering sustainability-related projects and initiatives. "Ethical decision-making" was noted by 30%, suggesting PRME's influence on ethical choices and "Community Engagement" was highlighted by 20%, indicating PRME's encouragement of involvement in community activities through social responsibility projects or partnerships (Table 1).

CONCLUSION

A. Lessons from Successful Cases: Real-World Examples

Examining real-world examples of organizations that have successfully implemented PRME can offer valuable insights into effective strategies and lessons learned. Successful cases often share common attributes:

1) *Strong Leadership*: Harvard Business School, led by Dean Nitin Nohria, showcases committed leadership in embedding ethical and sustainability principles in its curriculum from the outset [8].

2) *Faculty Development*: Rotterdam School of Management invests in faculty development for PRME success, providing workshops and training, ensuring prepared educators. [21].

3) *Effective Partnerships*: University of Exeter collaborates with businesses, government, and civil society, offering real-world case studies, enriching responsible management education. Bridging theory and practical application [23].

4) *Student Engagement*: University of St. Gallen fosters student involvement in PRME initiatives through sustainability challenges, fostering lifelong commitment to responsible management practices [24].

B. Recommendations for Improvement

Based on the research findings and lessons from successful cases, several recommendations for improving PRME implementation in Sri Lankan Business Schools emerge:

1) *Faculty Development*: Invest in faculty development programs focused on responsible management education. This will ensure educators are equipped to effectively integrate PRME principles into their teaching.

2) *Strengthen Stakeholder Engagement*: Foster deeper collaborations with businesses, government, and civil society organizations. Motivate them actively to design their curriculum and provide opportunities for experiential education.

3) *Student-Centered Approaches*: Devise post-student goods strategies for the responsible management education and enable them to participate in decision-making as well as create opportunities of experiential learning.

4) *Continuous Assessment*: Measure the effects of implementing PRME programs on students and society immediately. Constantly collect feedback

from stakeholders to change and refine strategies for curricular design as well as engagement.

5) *Advocacy for Policy Support*: Educational institutions as well as nations should advocate for responsible management education supportive policies at the institutional level and nationally.

6) *Knowledge Sharing*: Uphold knowledge sharing and cooperation among the institutions to learn from each other's successes as well failures.

The study developed into understanding the embedding and effect of PRME in Sri Lankan Business Schools, a global desire to develop sustainable management mechanisms. Even though the recent positive steps towards adjusting curricula to PRME principles challenges continue as, for example, regards to inclusion of moral reasoning and social justice but also due a need her hindering developmental goals with security faculty members. Stakeholder engagement proved to be pivotal; however, a myriad of opportunities does exist towards strengthening collaborations with businesses and government agencies as well as civil society institutions.

PRME principles potential to endow for cultivation ethical leadership and be competitive along with creating communal impact in Sri Lankan Business schools looks encouraging in the future. Challenges such as the question of curricular alignment and stakeholder engagement call for more concerted efforts but also provide valuable opportunities. The Sri Lankan Business Schools hold the prospect of establishing themselves as leaders in responsible management education and produce graduates who are highly successful professionally while being ethics, sustainability, and social responsibility champions. Reaching this utopia involves a series of conditions such as continual improvement, faculty training, collaboration with stakeholders and consistent application for measuring to improve sustainable development results.

REFERENCES

1. Braun, V., & Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, 3(2), pp. 77-101.
2. Bryman, A. (2016). *Social research methods*. Oxford University Press.

3. Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approach*. Sage publications.
4. Elo, S., & Kyngäs, H. (2008) 'The qualitative content analysis process', *Journal of Advanced Nursing*, 62(1), pp. 107-115.
5. Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.
6. Fink, A. (2013). *How to conduct surveys: A step-by-step guide* (5th ed.). Sage publications.
7. Guest, G., Bunce, A., & Johnson, L. (2006) 'How many interviews are enough? An experiment with data saturation and variability', *Field methods*, 18(1), pp. 59-82.
8. Harvard Business School. (2021). *Sustainability at Harvard Business School*. Available at <https://www.hbs.edu/sustainability/Pages/default.aspx> (Access 1 September 2023)
9. Hsieh, H. F., & Shannon, S. E. (2005) 'Three approaches to qualitative content analysis', *Qualitative Health Research*, 15(9), pp. 1277-1288.
10. Jayasinghe, J. A. S., & Samarathunga, W. M. K. D. S. (2017a) 'Embedding corporate social responsibility (CSR) into management curricula in Sri Lanka', *International Journal of Social Economics*, 44(12), pp. 1833-1850.
11. Jayasinghe, P., & Samarathunga, W. (2017b) 'Responsible management education in Sri Lanka: A case study on undergraduate business degree programs', *International Journal of Educational Management*, 31(7), pp. 948-963.
12. Linnenluecke, M. K., McKnight, B., Chalmers, K., & Murray, D. (2017) 'The role of accounting, accountability and management practices in the creation and allocation of value in public sector organizations: A case study', *Accounting, Auditing & Accountability Journal*, 30(1), pp. 118-139.
13. Lozano, R., Merrill, M. Y., Sammalisto, K., & Ceulemans, K. (2015) 'Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal', *Sustainability*, 7(4), pp. 4438-4462.
14. McDonnell, A., Gurd, B., & Lloyd-Walker, B. (2018) 'The art of engagement: How visual arts faculty and students perceive and create stakeholder engagement in social innovation', *Journal of Management & Organization*, 24(6), pp. 768-787.
15. Murray, A., Gourley, M., Heikkurinen, P., & Dacin, M. T. (2017a) 'What we talk about when we talk about 'responsible business'', *Organization Studies*, 38(4), pp. 365-374.
16. Murray, R., Haynes, K., Hudson, A., & White, M. (2017b) 'Management education and the sustainability imperative', *Business & Society*, 56(2), pp. 165-184.
17. Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015) 'Purposeful sampling for qualitative data collection and analysis in mixed method implementation research', *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), pp. 533-544.
18. PRME. (2021). *Signatories*. Available at <https://www.unprme.org/search> (Accessed 24 August 2023)
19. Rasche, A., & Gilbert, D. U. (2015) 'Decoupling responsible management education: Why business schools may not be creating the moral leaders of tomorrow', *Journal of Business Ethics*, 130(2), pp. 1-11.
20. Rasche, A., Gilbert, D. U., & Schedel, I. (2013) 'Cross-sector partnerships for systemic change: Systematizing collaboration processes', *Journal of Business Ethics*, 118(1), pp. 1-21.
21. Rotterdam School of Management. (2021). *Faculty Development at RSM*. Available at <https://www.rsm.nl/about-rsm/faculty-and-research/faculty-development/> (Accessed 20 August 2023)
22. United Nations Global Compact. (2007). *Principles for Responsible Management Education (PRME)*. Available at <https://www.unprme.org/> (Accessed 20 August 2023)
23. University of Exeter Business School. (2021). *Business in the community*. Available at <https://business-school.exeter.ac.uk/about/businessinthecommunity/> (Accessed 25 August 2023)
24. University of St. Gallen. (2021). *Sustainability at the University of St. Gallen*. Available at <https://www.unisg.ch/en/universitaet/nachhaltigkeit> (Accessed 25 August 2023)
25. Waddock, S., McIntosh, M., Kell, G., & Waddell, S. (2015) 'The evolution of the corporate responsibility movement', *Business & Society*, 54(2), pp. 155-192.

Original Article

Social Media Use of University Libraries in Sri Lanka: a Content Analysis

De Silva, A.P.U.

*Main Library, University of Kelaniya,
udayangani@kln.ac.lk*

ABSTRACT

Every academic or university library tries its best to cater to the users to get information relevant to the users' subject areas. To fulfill that target, academic libraries use various media to cater to their users best. The use of social media sites is one of the best ways to share knowledge with users. The present study was based on the State Universities of Sri Lanka, and it was conducted to find out first the available social media sites in academic libraries in Sri Lanka and then the most popular social media sites that used to share knowledge and information among user community in the respective university communities. There are eighteen state university in Sri Lanka. It was the population of the study. The websites of all the state universities and their faculties were selected as the sample of the study. This is a survey study and summative content analysis was used to collect data for the study. After analyzing data, it was clearly identified that Facebook was the most popular social media platform that is being used to share information about the library, programs of the library as well as the mother institute.

Index Terms- Social Media, Academic Library, Information Sharing, Facebook

INTRODUCTION

Knowledge and information have become key resources and most individuals try to capture information in a fraction of a second for their needs (Cascio & Montealegre, 2016). When considering

knowledge and information, a library is the most important organization that supports any individual to collect his or her information needs. Before the Information and Communication Technology (ICT) revolution, the conventional function of libraries was to collect, process, disseminate, store and utilize information to provide services to their users within a reasonable time and in the right way (Maponya, 2004). However, the situation has changed rapidly and knowledge and information are available in many forms through many other ways. Information providers are not always aware of the intellectual capacity of knowledge seekers. At the same time, the knowledge seeker's understanding of the knowledge sources is also not up to the required extent most of the time (Karunanayake & Nagata, 2007). To overcome this situation, modern librarians must be equipped with the necessary advanced Information Technology skills to run information systems, disseminate knowledge through digital media, online handling of book referencing and lending, and much more (Collins & Quan-Haase, 2012).

There are various types of libraries created based on the user categories such as academic, public, school, and other special libraries. Among them, academic libraries play a big role to cater better services to the expert community. It is said that, the library is the heart of the university and without the heart, universities are not able to survive well. At the same time, it is a big challenge for such libraries to disseminate and share knowledge with the university community

and expert society in the present era. An academic library as a center of excellence in the present university system should rethink and explore ways to improve its services. It must become a more effective and efficient learning organization to capture and disseminate knowledge within the library suite creating an impressive impact on the university community (Howard et al., 2018; Maponya, 2004). Owing to the rapid growth of ICT, academic library collections are no longer mere collections comprising just printed material. They are now equipped with large collections of multiple formats and media information such as e-books, e-journals, and e-databases (Maponya, 2004).

In the past era, people used to step into libraries to get information to fulfill their information needs. However, the situation has changed drastically as most individuals wish to gather information fast and have them at their fingertips; new technological concepts and tools are being used to effortlessly gather information. Consequently, acquiring and using information from libraries have a low demand among the general public and there is a high demand for online resources and services in the present society (Amarasekara & Marasinghe, 2020; Chandrasekar & Murugathas 2013). At the same time, digital natives, who grew up in the era of ubiquitous technology including the internet and computers, most require the digital library and digital concepts for their educational purposes (Dobrevá & others, 2010). Simultaneously, as discussed in the fifth Industrial Revolution (5IR) deep and multi-level collaboration between humans and machines is very important. So, it is necessary to develop deep connections with machines and humans in every field in this era (Noble, Mende, Grewal & Parasuraman, 2022).

As a solution for this situation, librarians would recognize the importance of clear, accessible online domains to attract and serve users

(Helmick, 2015). Social media are important tools for capturing external and competitive information to serve people's needs and it is a better place to engage in conversations with the user community (Bharati, Zhang & Chaudhury, 2013). Today social media has become a very popular concept among all present generations and it is clearly identified that social media of Web 2.0 are very convenient for academic libraries to promote and deliver their resources and services (Sriram, 2016). The main purpose of academic libraries is to provide resources and services to support the learning, teaching, and research of the users. Librarians of such libraries can make use of those social media to disseminate knowledge and library services to engage with their communities outside the precincts of the library. This study mainly focused on how far academic libraries use social media to promote their services and resources among the user community to achieve the purpose of the library.

This study mainly focused on the role of social media in university libraries in Sri Lanka. This study was conducted based on three objectives. They are,

- To identify the types of social media available and used in the university libraries in Sri Lanka
- To determine the purpose for which social media is applied in university libraries to promote functions and programs of the libraries, in Sri Lanka
- To identify the popular (commonly use among the majority) social media among the academic user community in the university libraries.

It is very easy to find the studies which are conducted related to social media usages in academic libraries in the present. The reason for that, social media has become the common topic for research trends in the present society.

Saleem, Aly and Genoni (2015) investigated that social media channels suchlike Facebook and Twitter are used perforate and digital communication, and blogging, YouTube and video sharing are popular media in Australia, South Africa and Iraq. How ever, Facebook and Twitter are not used to request information from the library by users and the social media platforms are used to market library services, announce library news and improve service delivery (Fainder, 2012; Rabatseta, Maluleka and Onyancha, 2021). There are more than billion users of Facebook in these countries. Due to the high usage of social media, the information gap has been reduced among academic librarians in the Iraq and Australia. At the same time, Twitter and Facebook was the most popular social media among academic libraries in Australia and UK (Palmer, 2014; Chatten & Roughley, 2016). Some studies reveled that Facebook offers a dynamic environment for academic libraries to cultivate relationships with user community in a proper way (Phillips, 2011).

In some studies, it is clear that social media have become not only a major common channel of communication among peers and relatives, but also an innovative, yet cost-effective avenue for academic libraries to enhance the quality of their services to patrons in the academic library system (Mensah, 2021).

In some cases in Kuwait, it was identified that academic librarians have a positive perception towards social media tools in marketing library information resources and services among their user community, but the support from the library management to use of social media tools in marketing purposes was very poor (Al-Awadhi and Al-Daihani, 2019).

It is interesting to note that early studies in Ghana indicated that that most of the university libraries lacked policy on the use of social media and lacked

the competence and motivation to use social media to make a remarkable difference in service delivery, but they have identified that social media are very useful for the academic societies (Ahenkorah-Marfo and Akussah, 2016).

Doney, Wikle, and Martinez (2020) indicated that most frequently posts of the Instagram accounts was showcasing posts specially highlighting library or campus resources of the academic libraries at land-grant institutions in the United States. Although, showcasing posts were the most common among the Instagram accounts analyzed, they also received the lowest number of likes, on average, and generated comments less compered with other post categories like crowd sourcing, humanizing, interacting, orienting, place making.

It was identified that social media postings included ten different codes such as archives; collections; events; exhibits; facility; library community; sentiments; services; site management; and university community in the academic library system. At the same time above mentioned codes were tied to three different themes. They are libraries create a sense of outreach and advocacy with the goal of establishing community connection, providing an inviting environment, and access to content as needed or desired (Harrison, Burrell, Velasquez and Schreiner, 2017).

Considering with the Sri Lankan context, there are few studies related to the social media studies in academic libraries. Weerasinghe & Hindagolla (2018), Amrakoon & Senevirathna (2014) and Amarakoon & Amarakoon (2012) examined that majority of the librarians (78.4%) in Sri Lanka used social network sites at their working place and among all social media sites, Facebook is the most famous site among them. The presentage was 64.7%. Further Amarakoon & Senevirathna stated that by using a Facebook sites, librarians promote their services and resources among their user

community. Athukorala (2020) investigated that, although the Facebook, Twitter, Instant messaging, blogs, and YouTube are very popular social media platforms in the Sri Lankan society, there was a less usage of these social media sites as a marketing tools in the academic libraries. At the same time more than 80% of academic libraries do not have their own Facebook account to share their information with the user community (Amarakoon & Senevirathna, 2014). Due to the inadequate training opportunities, lack of knowledge, privacy and identity theft, slow speed of internet and electricity failure, usage of social media in libraries for promoting library resources and services are very limited in Sri Lanka context (Amarakoon & Amarakoon, 2012).

RESEARCH METHODOLOGY

This is a mixed qualitative and quantitative study utilizing a survey designed to investigate the availability and use of social media by university libraries in Sri Lanka. There are eighteen university libraries in Sri Lanka and it is the population used for the present study. All 18 state universities were selected as the sample for the study. All universities have two or more faculties separately and the libraries attached to those faculties have developed a collection related to the subjects of the relevant faculty. All the websites related to these faculty libraries were studied.

Figure 1 shows the number of faculties that are attached to the sample of the studied universities. Simultaneously, summative content analysis was used to observe and collect data from the websites of university libraries. At the same time, the study covered all the social media sites to cross-check the data accuracy of the available information on the university websites. After gathering information, MS Excel was used to analyze the data, and graphs, tables, and charts were used for the data interpretation modes of this study.

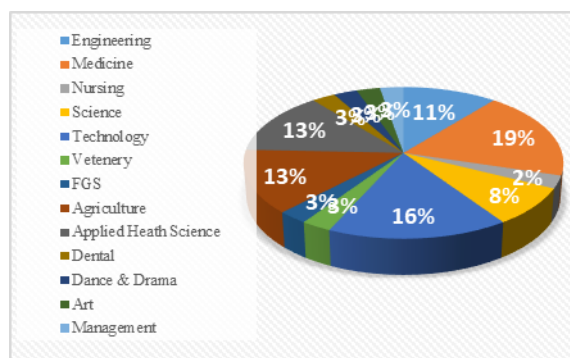


Figure 1: Number of Faculties of the Universities in Sri Lanka

(Survey data, 2022)

RESULTS AND DISCUSSION

Based on the summative content analysis on the websites of the university libraries during the 26th and 27th of November 2022, results revealed that 65% of the samples were the libraries that used social media connection with the home page of the library. 30% of the sample size did not display even social media icons on their websites. At the same time, one of the university library websites was not opened due to a technological error. So, these results are based on 11 websites of university libraries in Sri Lanka.

The main objective of this preliminary study was to identify the types of social media available and used in university libraries in Sri Lanka. Figure 2 clearly shows that Facebook, Twitter, YouTube, and Google + were the most commonly used social media sites of the university libraries. Simultaneously, Linked-In, Instagram, Flickr, RSS, Behance, and Messengers have very less demand from libraries. Anyhow, there is a new trend in using social media in the academic library system in the Sri Lankan context.

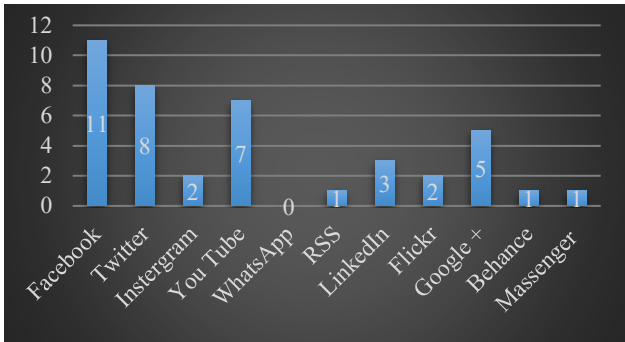


Figure 2: Usage of social media in university libraries (Survey data, 2022)

The second objective of the study was to determine the purpose for which social media is applied in university libraries in Sri Lanka. Based on the collected significant statements from social media postings, it was realized that most academic libraries use their social media sites to display background information related to the libraries and to make awareness the users regarding the programs conducted by the library or their mother institute. It was 22% of all others sharing information on the media. All the university libraries have shared their information on programs and other functions by using photo publishing. It was the most popular item on all social media sites. Although libraries were stores of information sources relevant to their mother institutes, they paid low attention to sharing information about information sources and their services to the user community.

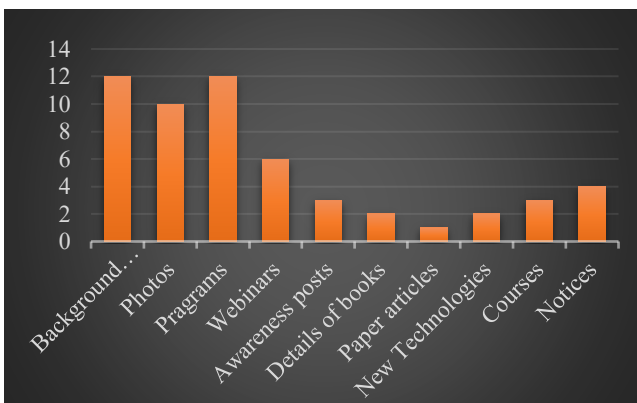


Figure 3: Purpose of using social media sites (Survey data, 2022)

After reviewing the collected data as a whole, it was realized that the most popular social media among the academic community was Facebook. Then Twitter, YouTube, and Google + took second, third, and fourth places, respectively.

CONCLUSIONS

This study mainly reported preliminary findings of the content analysis of the social media sites attached to the university libraries of Sri Lanka. It was clearly identified that there is a sharp trend towards social media sites in sharing information with the user community. Facebook, Twitter, YouTube, and Google+ are the most popular and attractive social media sites among the user community and staff of the university libraries. However, academic libraries used these social media sites to share basic information with their user community. Results showed that some libraries have already started sharing their resources and services by using social media sites with their user community. Besides, inadequate knowledge of information technology and technical errors that they have faced frequently are the common barriers that university libraries are faced.

REFERENCES

1. Ahenkorah-Marfo, Micheal and Akussah, Harry (2016), Being where the users are: Readiness of academic librarians to satisfy information needs of users through social media, *Library Review*, 65 (8/9), DOI 10.1108/LR-02-2016-0020
2. Al-Awadhi, Suha and Al-Daihani, Sultan M. (2019), Marketing academic library information services using social media, *Library Management*, 40 (3/4), DOI 10.1108/LM-12-2017-0132.
3. Amarakoon, L.R. and Senevirathne, T.M. (2014), Social media and library marketing: is

- Facebook being used effectively in promoting library resources and services of main libraries in Sri Lanka?, NILIS Symposium, DOI: 10.13140/2.1.2082.0483
4. Amarasekara, K.M.R.K. and Marasinghe, M.M.I.K. (2020). User Satisfaction on library resources and services: survey conducted in the main library of the Open University of Sri Lanka. *Journal of the University Librarians Association of Sri Lanka*, 23(2), pp.27–46. DOI:<http://doi.org/10.4038/jula.v23i2.8007>
5. Athukorala, A.W.V. (2020), The possibilities for information marketing in libraries with social media: a study based on Sri Lankan university libraries, *Journal of Institute of Human Resource Advancement*, 7(2), <https://www.ihra.cmb.ac.lk/wp-content/uploads/2021/12/V7-12-04.pdf>
6. Bharati, P., Zhang, C., and Chaudhury, A. (2013). Social Media Assimilation in Firms: Investigating the Roles of Absorptive Capacity and Institutional Pressures, *Information Systems Frontiers*, 16(2), Springer. DOI: 10.1007/s10796-013-9433-x.
7. Cascio, W.F. & Montealegre, R (2016). How technology is changing work and organizations. *Annual Review of Organizational Psychology and Organizational Behavior*, 3(1), pp. 349-375. DOI: 10.1146/annurev-orgpsych-041015-062352
8. Chandrasekar, K. and Murugathas, K., (2013). An assessment of user satisfaction on library services: a case study of undergraduate Biology students at the University of Jaffna. *Journal of the University Librarians Association of Sri Lanka*, 16(1), pp.34–45. DOI: <http://doi.org/10.4038/jula.v16i1.5196>
9. Collins, G., & Quan-Haase, A. (2012). Social media and academic libraries: current trends and future challenges. *Proceedings of the American Society for Information Science and Technology*, 49, p.p.48–68.
10. Dobрева M., McCulloch E., Birrell D., Ünal Y., Feliciati P. (2010). Digital Natives and Specialised Digital Libraries: A Study of Europeana Users. In: Kurbanoglu S., Al U., Lepon Erdoğan P., Tonta Y., Uçak N. (eds). *Technological Convergence and Social Networks in Information Management. IMCW 2010. Communications in Computer and Information Science*, vol 96. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-16032-5_5
11. Doney, Jylisa, Wikle, Olivia and Martinez, Jessica (2020), Likes, comments, views: a content analysis of academic library Instagram posts, *Information Technology and Libraries*, Sep. 2020, <https://doi.org/10.6017/ital.v39i3.12211>.
12. Fainder, David J. (2012), Social media for academic libraries, *Social Media for Academics: a practical guide*, <https://ir.lib.uwo.ca/fimspub/27/>
13. Harrison, Amanda, Burrell, Rene, Velasquez, Sarah, & Schreiner, Lynnette (2017), Social Media Use in Academic Libraries: A Phenomenological Study, *The Journal of Academic Librarianship*, 43 (2017), 248–256p, <http://dx.doi.org/10.1016/j.acalib.2017.02.014>
14. Helmick, S.C. (2015). *Mobile social marketing in libraries*. London: Rowman & Littlefield.
15. Howard, H., Huber, S., Carter, L. & Moore, E. (2018). Academic libraries on social media: finding the students and the information they want. *Information Technology & Libraries*, pp. 8-18. <https://doi.org/10.6017/ital.v37i1.10160>

16. Karunanayake, K., & Nagata, H. (2007). Some affected variables of information needs occurrence of an information seeker: a comprehensive hypothetical model. *Journal of the University Librarians, 11*, p.p. 50-78.
17. Maponya, P.M. (2004). Knowledge management practices in academic libraries: a case study of the University of Natal, Pietermaritzburg Libraries. <http://mapule276883.pbworks.com/f/Knowledge%20management%20practices%20in%20academic%20libraries.pdf>. (Accessed 10th Jan. 2021)
18. Mensah, Monica (2021), Towards a framework to optimise social media usage in academic libraries in Ghana: an empirical study, *African Journal of Library, Archives & Information Science, 31* (2),
19. Palmer, Stuart (2014), Characterizing university library use of social media: a case study of Twitter and Facebook from Australia, *The Journal of Academic Librarianship*, vol. 40 (2014), <http://dx.doi.org/10.1016/j.acalib.2014.08.007>.
20. Saleem, Maysoon, Aly, Anne & Genoni, Paul (2015), Use of social media by academic librarians in Iraq, *New Library World*, vol. 116 (11/12), DOI 10.1108/NLW-03-2015-0018.
21. Sriram, V. (2016). Social media and library marketing: experiences of KN Raj library. *Journal of Library & Information Technology, 36*(3), p.p 153-157 & 5. doi: 10.14429/djlit.36.3.9810
22. Noble, S.M., Mende, M., Grewal, D. & Parasuraman, A. (2022). The fifth industrial revolution: how harmonious human-machine collaboration is triggering a retail and service [R]evolution. *Journal of Retailing, 98* (2), 199-208p. <https://doi.org/10.1016/j.jretai.2022.04.003>
23. Weerasinghe, Sureni & Hindagolla, B.M.M.C.B. (2018). Use of Social Network Sites (SNS) by academics in the workplace: perspective of University Librarians in Sri Lanka. *Journal of the University Librarians Association of Sri Lanka*, Vol.21, Issue 2, July 2018, 21-43. DOI: <https://doi.org/10.4038/jula.v21i2.7916>.
24. Chatten, Zelda & Roughley, Sarah (2016) Developing social media to engage and connect at the university of Liverpool library, *New Review of Academic Librarianship, 22*:2-3, 249-256, DOI: 10.1080/13614533.2016.1152985.
25. Rabatseta, Benford, Maluleka, Jan R. and Onyancha, Omwoyo Boshire (2021), Adoption and use of social media in academic libraries in South Africa, *South Africa Journal of Library & Information Science, 87* (1), <http://sajlis.journals.ac.za> doi:10.7553/87-1-1926.
26. Phillips, N.K. (2011), Academic library use of Facebook: building relationships with students, *The Journal of Academic Librarianship, 37* (6).
27. Amarakoon, L.R. & Amarakoon, R.S.K. (2012), Web 2.0 social media and libraries: role of social media in promoting library and information services in an academic setting: with special reference to university of Bolton (UoB), academic centre Sri Lanka library, *Proceedings of the NILIS/University of Colombo Symposium: Changing library strategies for the new generation of users*, https://www.researchgate.net/publication/264045208_Web_20_Social_Media_and_Libraries_Role_of_social_media_in_promoting_library_and_information_services_in_an_academic_setting_with_special_reference_to_University_of_Bolton_UoB_Academic_Centre_Sri_Lanka

Original Article

Systematic Review: Safety and Efficacy Comparison of Laser Therapy With And Other Resurfacing Technology

Hettihewa L.M

Department of Health and Medical Science Faculty of Health Sciences, CINEC Campus

Menik.Hettihewa@cinec.edu

ABSTRACT

There is an increasing demand of almost all young and adult population for the noninvasive cosmetic procedures specially to enhance the facial appearance and the requirement has expanded all over the world. This review was designed to identify and summarize the literature/evidence from different types of research/clinical studies conducted in facial resurfacing methodologies. A systematic review was designed and conducted in relation to facial resurfacing and rejuvenating techniques using data from PubMed, MEDLINE Cochrane database and Scopus. Systematic review protocol guidelines were used for research questions, aim of the review and PICO breakdown, eligibility criteria and used search engine and extraction of data. A minimum of 17 clinical studies and reviews were identified including randomized clinical trials. Significant results have been obtained in some clinical trials about techniques of rejuvenation and some studies have elucidated contrasting evidence. In most of the work, ablative and non-ablative laser therapy had been compared and we found that some results were compatible, and others showed contrasting evidence. In conclusion, more high-quality randomized control clinical trials are needed to decide on better safety and effectiveness of ablative or non-ablative laser therapy vs conventional treatments.

Index Terms- Laser Therapy, Face Resurfacing Technology

INTRODUCTION

Esthetic skin procedures have become a more demanded area among the younger generation of the world. There is a wide range of available techniques used for skin resurfacing [1]. Skin resurfacing treatment will mainly focus on the skin

complexion and removal of the top layer of the skin [1,2]. Our literature survey showed that this enhancing complexion procedure can be done by different methods [1-5]. In this review process, we concentrate on reviewing the therapeutic efficacy and safety of different types of laser technology, chemical peeling in rejuvenation and other methods which are also used in the practice. In all studies, objective of the facial resurfacing is mainly to remove of top layer of the skin by damaging the skin layer to regenerate the new young cells [3] All methods which are used currently, reduce fine and coarse wrinkles, fine lines, age specific spots and other blemishes [5,6]. Demand for rejuvenation is now more common among adult and aged generation in all over the world and had made their appearance of the face and neck drastically [6]. Some research findings showed that individual facial assessment is mandatory before the commencement of the therapy while some others have not given any data about the pretreatment evaluation. The safety, efficacy and post treatment complications have been compared and studied only in few studies [7,8].

CURRENT TREATMENT MODALITIES

Before the laser resurfacing, soft tissue fillers like fat, collagen or hyaluronic acid are commonly injected into wrinkled area in both neck and face [7,8,9]. With the practice of facial filling, research evidence showed that hyaluronic acid, calcium hydroxypaptite, fat is commonly used with safety [7,8]. Further, clinical trials showed that effective time duration of facial filling last for 6-12 months and repeated treatment therefore is required to regain the appearance when compared to the lase therapy [7,9,10]. Goldman *et al* with his research group had found out that there is no significant difference in the treatment groups of facial filling alone and facial filling followed with laser treatment on face [9]. In contrast, Fernando *et al* had

published a paper with a result of the concomitant use (same day) of laser and HA fillers for facial rejuvenation represents an effective and safe strategy which improves clinical results and patient's satisfaction [10]. This shows contradictory results a decision on the effectiveness and safety of combination filler/laser treatments [10]

CHEMICAL PEELING

Chemical peeling has been practiced on the face to remove the dead upper layer of the skin and stimulate the rejuvenation of the new skin cells [10]. Chemical peels are different types, and superficial and medium peels will improve the skin texture wrinkles and pigmentation and recovery will be smooth. Deep peels are used for more severe dermatological conditions and may result in swelling and blisters after the treatment [11]. Review published by Hesham *et al*, had identified that there is no difference in fractional erbium YAG with glycolic acid peel in facial treatment [11]. In support to this finding, Hassan *et al* also had conducted comparative study on CO₂ laser and chemical peeling and found out the high concentration of fractional CO₂ laser and chemical peeling had shown equally effective results in treatment of acne vulgaris [12]. But they specifically highlighted the fractional CO₂ laser is superior to mandelic acid chemical peeling in treatment of post acne scars even in high concentration [12]

MECHANISM OF LASER FACIAL RESURFACING

Different types of laser therapy is used to rejuvenate the skin in cosmetic industry to enhance the tone, texture and reduce pigmentation of the skin. Laser therapy uses the process of photothermolysis which will release a beam of light energy to the affected area of skin, and this will destroy the outer layer of the skin, which is epidermis. Laser beams cause heating of water at epidermis and vaporize the tissue to get filled by collagen fibers. The wavelength of the light must be chosen as per the color and the shape of the target area [3,5]. With this treatment, stimulation of dermis will be commenced with cellular and tissue repairing and collagen production. This revitalization procedure will make smooth and youthful appearance of the person [3-5].

As per the published reports in this study, we found that laser therapy is collectively used in removing a wide variety of scars in addition to the wrinkles [5]. Most of the studies identified that minimum recovery time is one of the advantages of laser treatment. Patients can resume day to day activities after the session and it has been recorded for the treatment of acne, birth marks, excessive hair growth problems, sagging skin conditions age related pigmentations and lesions, vascular lesion which are cosmetically affected, wrinkles and age spots and most importantly the precancerous lesions [3-6].

DIFFERENT TYPES OF LASER THERAPY

Laser therapy uses different types of lasers such as Erbium, CO₂ and diode lasers. There are two main types of ablative and non-ablative laser therapy.

Dermatologists and clinicians use fractional CO₂ lasers which are a mixture of 3 gases of 10-20% CO₂, 10-20% nitrogen and Helium. This is noninvasive and removes the damaged and aged skin and stimulates collagen formation and result in firm and healthy young skin. Erbium laser resurfacing has been done to remove surface level, deep lines and wrinkles. This has become popular due to the minimum burning of surrounding tissues [1,2,4]. If the skin is dark, treatment with Neodymium YAG has been considered because it has a longer wavelength that goes deeper into the skin effectively bypassing the melanin in the upper layer of the skin [2-4]

Many randomized control trials were reviewed to find out the best resurfacing technique [1-17]. Reviews articles were also studied and multiple authors in review articles had advocated improving the study designing and quality in future. [13,17]. In relation to the safety and efficacy, 1540-nm fractional erbium glass laser in the non-contact mode had been identified as safe and effective treatment for facial photodamage [15]. In addition to that another clinical trial showed that treatment of photodamage with a fractionated 1927-nm nonablative thulium laser is a promising new therapeutic option [16] and showed that two treatments with a 1927nm non-ablative fractionated thulium laser produced moderate to marked improvement in overall appearance and pigmentation with high patient satisfaction [16]. The response to treatment has been maintained for

three months follow up [16,17]. Another method of treatment for aging skin was identified as photo rejuvenation. Phototherapy had been very successful in controlling the regular pigmentation effectively. Light emitting diode (LED) is identified as novel light source and effective in wrinkles skin laxity. Yoon lee et al had conducted a prospective randomized double blind, split face clinical study and recommended that molecular level reactivation of skin rejuvenation with LED treatment and its safety [22,23].

A study conducted by Christopher *et al*, found out that techniques supported with artificial intelligence is much better than traditional methods of results of facial rejuvenating and resurfacing [24]. Review published by Macrene *et al* had suggested that multi-center clinical trial evidence for the better safety and efficacy with the fractional carbon dioxide laser treatment [25]. In contrast Yang *et al* researched that both nonablative fractional laser and ablative CO₂ fractional laser are effective and safe treatment for striae distensae of Asian skin. They further recommend that neither of treatment showed have not shown any greater clinical improvement than the other treatment. [26]

Considering all above research work and their evidence, treatment modalities for facial resurfacing had resulted different in individual work and vary with the type of the disease and the facial presentation. Article published in Journal of cosmetic and laser therapy by Fereshtech *et al* had identified that safety/efficacy and cost effectiveness of CO₂ fractional laser therapy in comparison to other methos of rejuvenation is high [18]. Cost for the treatment modalities had varied with the treatment type for the type of skin lesion. Farnoosh *et al* found out that the efficacy and safety of ablative laser were not higher than those of non-ablative laser in skin rejuvenation [19] Most importantly, minim invasion and permanent skin solution are the main reasons for the popularity of the laser skin treatment with very impressive results.

RECOMMENDATIONS

As per the finding with the former research and review articles, we only can recommend the performance of laser-based resurfacing is

considered as safe and efficient method of making expected skin appearance only with the hands of highly trained, knowledgeable professional.

Therefore, when you decide for laser skin resurfacing, with this study, we recommend discussing with the cosmetic surgeon o dermatologist about your focus on the treatment goals and the existing skill problem which you want to address and the expected results. In relation to efficacy and safety, considering all the above research work published, we identified contrasting results for recommending ablative laser and non-ablative laser therapy. Therefore, we need more high-quality randomized control clinical trials to decide on the safety and effectiveness of ablative or non-ablative laser therapy vs conventional treatments.

REFERENCES

1. Lipozencic J, Bukvic Mokos Z. Dermatologic lasers in the treatment of aging skin. *Acta Dermatovenerol Croat.* 2010;18(3):176–180. [PubMed] [Google Scholar]
2. Alster TS, Lupton JR. Lasers in dermatology. An overview of types and indications. *Am J Clin Dermatol.* 2001;2(5):291–303. [PubMed] [Google Scholar]
3. Smith KC, Schachter GD. YSGG 2790-nm Superficial Ablative and Fractional Ablative Laser Treatment. *Facial Plast Surg Clin North Am.* 2011;19(2):253–260. [PubMed] [Google Scholar]
4. Manstein D, Herron GH, Sink RK, et al. Fractional Photothermolysis: A New Concept for Cutaneous Remodeling Using Microscopic Patterns of Thermal Injury. *Lasers Surg Med.* 2004;34:426–438. [PubMed] [Google Scholar]
5. Malinowska S, Jaguś D, Woźniak W, Mlosek RK. Usefulness of high-frequency ultrasound in the monitoring of laser treatment of acne scars. *J Ultrason.* 2021;20(83):e279-e283. doi: 10.15557/JoU.2020.0049. Epub 2020 Dec 18. PMID: 33500795; PMCID: PMC7830061.
6. Alexiades-Armenakas MR, Dover JS, Arndt KA. Fractional laser skin resurfacing. *J Drugs*

- Dermatol.* 2012;11(11):1274–1287. [PubMed] [Google Scholar]
7. Foster KW, Moy RL, Fincher EF. Advances in plasma skin regeneration. *J Cosmet Dermatol.* 2008;7(3):169–179. [PubMed] [Google Scholar]
 8. Tierney EP, Hanke CW. Ablative fractionated CO₂ laser resurfacing for the neck: prospective study and review of the literature. *J Drugs Dermatol.* 2009 Aug;8(8):723-31. PMID: 19663109.
 9. Goldman MP, Alster TS, Weiss R. A randomized trial to determine the influence of laser therapy, monopolar radiofrequency treatment, and intense pulsed light therapy administered immediately after hyaluronic acid gel implantation. *Dermatol Surg.* 2007 May;33(5):535-42. doi: 10.1111/j.1524-4725.2007.33111.x. PMID: 17451575.
 10. Urdiales-Gálvez F, Martín-Sánchez S, Maíz-Jiménez M, Castellano-Miralla A, Lionetti-Leone L. Concomitant Use of Hyaluronic Acid and Laser in Facial Rejuvenation. *Aesthetic Plast Surg.* 2019 Aug;43(4):1061-1070. doi: 10.1007/s00266-019-01393-7. Epub 2019 May 9. Erratum in: *Aesthetic Plast Surg.* 2019 Sep 17;: PMID: 31073742; PMCID: PMC6742610.
 11. Hesham A. Shokeir 1 , Maha R. Abo Eittah 2 , Noura A. El Seessy 3 Comparative Study on Fractional Ablative Erbium: YAG Laser Versus Chemical Peeling in Treatment of Melasma Sys *Rev Pharm* 2020;11(12):593-599
 12. Hassan M. El-Fakahany, Walid M. Mohamed, and Sheyam S. Amer. Fractional CO₂ Laser and Chemical Peeling for Treatment of Acne and Acne Scars: A Comparative Study. *MJMR*, Vol. 31, No. 1, 2020, pages (66- 69).
 13. Halbina A, Trznadel-Grodzka E, Rotsztein H. Fractional laser therapy - the next step in alleviating the symptoms of skin aging (own observations). *Prz Menopauzalny.* 2014 May;13(2):132-5. doi: 10.5114/pm.2014.42716. Epub 2014 May 21. PMID: 26327843; PMCID: PMC4520352.
 14. Lapidoth M, Halachmi S, Cohen S, Amitai DB. Fractional CO₂ laser in the treatment of facial scars in children. *Lasers Med Sci.* 2014 Mar;29(2):855-7. doi: 10.1007/s10103-013-1305-6. Epub 2013 Mar 26. PMID: 23529372.
 15. Lapidoth M, Adatto M, Halachmi S. Treatment of actinic keratoses and photodamage with non-contact fractional 1540-nm laser quasi-ablation: an ex vivo and clinical evaluation. *Lasers Med Sci.* 2013 Feb;28(2):537-42. doi: 10.1007/s10103-012-1103-6. Epub 2012 Apr 27. PMID: 22538843.
 16. Weiss ET, Brauer JA, Anolik R, Reddy KK, Karen JK, Hale EK, Brightman LA, Bernstein L, Geronemus RG. 1927-nm fractional resurfacing of facial actinic keratoses: a promising new therapeutic option. *J Am Acad Dermatol.* 2013 Jan;68(1):98-102. doi: 10.1016/j.jaad.2012.05.033. Epub 2012 Oct 2. PMID: 23041112.
 17. Brauer JA, McDaniel DH, Bloom BS, Reddy KK, Bernstein LJ, Geronemus RG. Nonablative 1927 nm fractional resurfacing for the treatment of facial photopigmentation. *J Drugs Dermatol.* 2014 Nov;13(11):1317-22. PMID: 25607696.
 18. Pannucci CJ, Reavey PL, Kaweski S, Hamill JB, Hume KM, Wilkins EG, Pusic AL. A randomized controlled trial of skin care protocols for facial resurfacing: lessons learned from the Plastic Surgery Educational Foundation's Skin Products Assessment Research study. *Plast Reconstr Surg.* 2011 Mar;127(3):1334-1342. doi: 10.1097/PRS.0b013e318204361d. PMID: 21364435; PMCID: PMC3079206.
 19. Alexiades-Armenakas M, Sarnoff D, Gotkin R, Sadick N. Multi-center clinical study and review of fractional ablative CO₂ laser resurfacing for the treatment of rhytides, photoaging, scars and striae. *J Drugs Dermatol.* 2011 Apr;10(4):352-62. PMID: 21455544.
 20. Ansari, Fereshteh & Sadeghi-Ghyassi, Fatemeh & Yaaghoobian, Barmak. (2018). The

- clinical effectiveness and cost-effectiveness of fractional CO₂ laser in acne scars and skin rejuvenation: A meta-analysis and economic evaluation. *Journal of Cosmetic and Laser Therapy*. 20. 1-4. 10.1080/14764172.2017.1400173.
21. Seirafianpour, F., Pour Mohammad, A., Moradi, Y. *et al.* Systematic review and meta-analysis of randomized clinical trials comparing efficacy, safety, and satisfaction between ablative and non-ablative lasers in facial and hand rejuvenation/resurfacing. *Lasers Med Sci* 37, 2111–2122 (2022). <https://doi.org/10.1007/s10103-022-03516-0>
22. Lee SY, Park KH, Choi JW, Kwon JK, Lee DR, Shin MS, Lee JS, You CE, Park MY. A prospective, randomized, placebo-controlled, double-blinded, and split-face clinical study on LED phototherapy for skin rejuvenation: clinical, profilometric, histologic, ultrastructural, and biochemical evaluations and comparison of three different treatment settings. *J Photochem Photobiol B*. 2007 Jul 27;88(1):51-67. doi: 10.1016/j.jphotobiol.2007.04.008. Epub 2007 May 1. PMID: 17566756.
23. Ablon G. Phototherapy with Light Emitting Diodes: Treating a Broad Range of Medical and Aesthetic Conditions in Dermatology. *J Clin Aesthet Dermatol*. 2018 Feb;11(2):21-27. Epub 2018 Feb 1. PMID: 29552272; PMCID: PMC5843358.
24. Zachary T. Elliott, Alekya Bheemreddy, Michele Fiorella, Ann M. Martin, Vanessa Christopher, Howard Krein, Ryan Heffelfinger, Artificial intelligence for objectively measuring years regained after facial rejuvenation surgery, *American Journal of Otolaryngology*; 2023,44; 2.
25. Alexiades-Armenakas M, Sarnoff D, Gotkin R, Sadick N. Multi-center clinical study and review of fractional ablative CO₂ laser resurfacing for the treatment of rhytides, photoaging, scars and striae. *J Drugs Dermatol*. 2011 Apr;10(4):352-62. PMID: 21455544.
- 26, Yang YJ, Lee GY. Treatment of Striae Distensae with Nonablative Fractional Laser versus Ablative CO₂ Fractional Laser: A Randomized Controlled Trial. *Ann Dermatol*. 2011 Nov;23(4):481-9. doi: 10.5021/ad.2011.23.4.481. Epub 2011 Nov 3. PMID: 22148016; PMCID: PMC3229942.

AUTHOR GUIDELINES

1. EDITORIAL PROCESS

All submissions endure a peer review process and are ultimately approved by the Editorial Board. Every paper undergoes an external peer review process utilizing the single-blind approach. This means that the authors are not aware of the identities of the reviewers and editors. The editor-in-chief and the journal manager utilize an expedited evaluation approach, with only a limited number of publications undergoing comprehensive external peer review. This approach allows authors to promptly submit their articles to a more suitable journal.

2. SUBMISSION CHECK LIST

- The structure as per the guidelines
 - Title page – check information in author instructions
 - Format – check the journal guidelines
 - Language – please get professional editing before submission
 - Accuracy of data – all authors are encouraged to double check the accuracy of data
 - All authors approval – please check all authors approval before submission
 - Authors list – all details must be done in the title page.
 - Cover letter – This letter should introduce your paper and outline why your work is important and suitable publication at this time
-

3. PREPARATION OF MANUSCRIPT

Manuscripts written only in English are accepted. CINEC Academic Journal does not levy article submission charges or article processing charges from authors. The submission of a manuscript will be taken to imply that the work is original and it or a similar paper (other than an abstract) has not been, and will not be submitted elsewhere concurrently for publication. The content of the manuscript is the sole responsibility of the authors. All manuscripts are peer reviewed. This journal uses double-blind review, which means that both the reviewer and author identities are concealed from the reviewers, and vice versa, throughout the review process. Authors must provide names of three potential referees with complete postal and e-mail addresses. However, the editors are not obliged to use the services of referees provided by authors. All manuscripts will be reviewed by two experts in the area of specialization concerned. If there are discrepancies between the comments of the two reviewers, the manuscript will be sent to a third reviewers before taking the final decision. The comments of the reviewers will be sent to the authors and the authors are expected to submit the revised version within three weeks of receiving the comments. Manuscripts must be typed using Times New Roman, font size 12 in double space throughout Title page, Abstract, Text, References and Tables. Indicate the authority for all Latin names only once, when the name is first mentioned in the text. All abbreviations should be spelt out at first mention in the abstract as well as in the text body. CINEC

academic journal is referred, peer reviewed open access journal publishing high quality papers on all aspects of higher education streams in Humanity and education, social sciences, business & management, engineering, information technology, health and medical sciences, maritime sciences and maritime engineering. All the articles submitted to the journal are scrutinized and peer reviewed by a registered external and internal reviewer panel approved by the editorial board.

4. MANUSCRIPT CATEGORIES

Original Research articles

Research Articles should include an Abstract, Keywords, Introduction, Methodology, Results and Discussion, Conclusion. References should be prepared according to the “Guidelines for the preparation of manuscripts”

Research communications

Document as research Communications are important to publish about new findings in a specific area of research which can be useful for rapid publication before completing the full study. Manuscript should include subsections like an Abstract, Keywords, Introduction, Methodology, Results & Discussion, Conclusion and References but it should be smaller than original research publication. Maximum number of words is 1250 including Figures, Tables and References.

Correspondence

Correspondence will be accepted regarding one or more articles in the preceding four issues of the Journal, as well as Letters to the Editor. Articles covering important scientific events or any other news of interest to scientists, reviews of books of scientific nature, articles presenting views on issues related to science and scientific activity will also be considered. Publication will be made at the discretion of the Editor-in Chief. Maximum number of words is 1,500 including Figures, Tables and References. A Table/Figure occupying half a page will be considered as 400 words

Observational studies

These types of works should be submitted with the relevant approvals obtained for the work, including the full name of the authority that approved the study eg. Research committee and Ethical clearance. If there are no approval,

Letters to editors

Letters to the Editor are correspondence regarding articles previously published in the CAJ and must be submitted within 12 months of the article’s publication to be considered for possible publication. The author of that article will be given the opportunity to respond. Letters should be no longer than 500 words, including references, if any, and must contain a clear message or point for readers. Letters may be edited for clarity or length and can be published at the Editor’s discretion.

Systemic reviews and meta analysis

It should be a standard systematic review paper as per the Cochrane guidelines. It should be clearly formulated document including the step by step analysis to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review. These reviews differ substantially from narrative-based reviews or synthesis articles. Statistical

methods (meta-analysis) may or may not be used to analyze and summarize the results of the included studies.

5. ORIGINAL RESEARCH

Title page

- Title (maximum 85 characters)
- All authors names and full addresses
- Corresponding author's postal and email address
- A short title (maximum 46 characters, including spaces)
- A minimum of four keywords describing the manuscript
- Word count of the full article, excluding references and figure legends

ABSTRACT

Abstract within 300 words should be submitted and it should be self-explained citation-free abstract and indicating briefly the purpose of the research, methodology, key results and major conclusions. Abstract should be in a single paragraph with short sentence. It should not be done with any type of subheading or point list and it should not be written with any type of non-standard abbreviations. If the authors feel that it is essential to include the abbreviations, they must be defined at their first mention in the abstract itself.

Introduction

Introduction should include concepts, hypothesis and related literature survey, research requirement, selected problem of the research. Reference citation [1] can be done and should be included for showing the existing importance of current work. This section should be brief, with no subheadings unless unavoidable. State the objectives of the work and provide an adequate background related to your work, avoiding a detailed literature survey or a summary of the results.

Materials and methods

This should provide sufficient information for other workers to repeat the study. This part should contain enough detail of your research method and materials or data. It should include sources of chemicals generic names of drugs etc. Use SI symbols. It can be divided into subdivisions if several methods are described. Methodology should be written as the series of methods in the order of conduction concisely in detail by maintaining continuity of the texts. Mathematical expressions and symbols should be inserted using equation tool of Microsoft word. References may be added for used equations to support its authenticity.

Results and Discussion

Results should read as a narrative leading the reader through the experiments. This section can be described under subheadings or may be combined. Results should be included as a flow of work you conducted and this may explore the significance of the results of the work. Repetition of the results are not recommended in different formats. Discussion should not re state the results. Extensive citations and discussion should not be done at this section but you can describe and highlight novelty of your work.

Figures and Tables

All figures and tables have to be numbered properly with the descriptive titles and legends. Figures and tables should be embedded at appropriate place within manuscript. Each Figure/Table must be explained within the text by referring to corresponding figure/table number. There should not be any unexplained or unnumbered Figure/Table in the manuscript. Table should be done using Microsoft word and cited consecutively in the text. Table should be covered with a descriptive title and legend of the table should be self-explanatory with numerical measurements.

Conclusions

Each manuscript should contain a discussion section with your justification of the results and comparison with the available result in the research publications in relation to your study area. Discussion should highlight the importance of the research finding to the next level of your research extension for future planning and suggestion for other researchers. Conclusion can be the final part of your manuscript may contain around 150 – 200 words including the major result of the work, future applications, importance, research limitation, relevance, application and recommendation. Do not use any subheading, citation, references to other part of the manuscript, or point list within the conclusion.

Declarations

Actual or perceived conflicts of interest for all authors must be declared. It includes, employments, grants, ownership, shares, royalties, patents, memberships.

Funding

Please detail all the sources of funding relevant to the research. If research is not funded, author can mention it as tis research did not receive ay specific grant from any funding agency of public or private.

Study Limitations

Provide all possible limitation faced in the study which might significantly affect research outcome, If not applicable write, none.

Acknowledgments

Please do brief statement

All acknowledgments (if any) may be included before the references and it should be the list of peoples who supported in different ways for the work but not listed in the author list.

Conflict of Interests

Declare any potential conflict of interest exist in this publication.

Human and Animal Related Study

If the work involves the use of human/animal subjects, each manuscript should contain the following subheadings under the declarations section-

Ethical Approval

Provide ethical approval authority with name with the reference number. If ethical approval is not required.

Informed Consent

Write a statement of informed consent taken from the participants to publish this research work. The editor may ask to upload scan copy if required.

References

All references should be cited within the text correctly; do not add only list of references without

citation within the text. All cited references should be listed after declarations section in the following style-

Hou WR, Hou YL, Wu GF, Song Y, Su XL, Sun B, et al. cDNA, genomic sequence cloning and overexpression of ribosomal protein gene L9 (rpL9) of the giant panda (*Ailuropoda melanoleuca*). *Genet Mol Res*. 2011;10: 1576-1588.

Devaraju P, Gulati R, Antony PT, Mithun CB, Negi VS. Susceptibility to SLE in South Indian Tamils may be influenced by genetic selection pressure on TLR2 and TLR9 genes. *Mol Immunol*. 2014 Nov 22. pii: S0161-5890(14)00313-7. doi: 10.1016/j.molimm.2014.11.005

Online articles

Huynen MMTE, Martens P, Hilderlink HBM. The health impacts of globalisation: a conceptual framework. *Global Health*. 2005;1: 14. Available from: <http://www.globalizationandhealth.com/content/1/1/14>

Books

Bates B. *Bargaining for life: A social history of tuberculosis*. 1st ed. Philadelphia: University of Pennsylvania Press; 1992.

Book chapters

Hansen B. New York City epidemics and history for the public. In: Harden VA, Risse GB, editors. *AIDS and the historian*. Bethesda: National Institutes of Health; 1991. pp. 21-28.

New media (blogs, web sites)

Allen L. Announcing PLOS Blogs. 2010 Sep 1 [cited 17 March 2014]. In: PLOS Blogs [Internet]. San Francisco: PLOS 2006 – . [about 2 screens]. Available from: <http://blogs.plos.org/plos/2010/09/announcing-plos-blogs/>.

Data bases

Roberts SB. QPX Genome Browser Feature Tracks; 2013 [cited 2013 Oct 5]. Database: figshare [Internet]. Available from: http://figshare.com/articles/QPX_Genome_Browser_Feature_Tracks/701214

6. OPEN ACCESS POLICY

CINEC Academic Journal provides immediate open access to its content on the principle that making research freely available to the public supports a greater global exchange of knowledge. Full-text access to scientific articles of the journal is presented on the official website in the Archives section.

The CINEC Academic Journal is made immediately accessible to the public based on the premise that making research freely accessible to the general public contributes to a larger transfer of information around the world. The Archives part of the official website provides customers with access to the full text of the scientific articles that are published in the Journal. This is in accordance with the Sri Lanka National Science Foundation open access.

The licensing policy is compatible with most of the open access and archiving policies. The journal is an open access journal, which means all its content is freely available without charge to the users or their institution. Users are allowed to read, download, copy, distribute, print, search, or link to the full

texts of the articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author as long as they cite the source.

6. PLAGIARISM POLICY

CINEC Academic Journal, is dedicated to upholding the highest standards of academic integrity and ethical publishing. Plagiarism undermines the fundamental principles of scholarly work and erodes the trust of our readers and the broader academic community. This Plagiarism Policy outlines the journal's approach to identifying and addressing plagiarism in submitted manuscripts.

1. Definition of Plagiarism:

Plagiarism is the act of presenting someone else's work, ideas, or intellectual property as one's own without proper attribution. This includes, but is not limited to, copying and pasting text, paraphrasing without proper citation, and using someone else's ideas without acknowledgment.

2. Manuscript Submission:

Authors submitting manuscripts to CINEC Academic Journal affirm that:

- The work is original, and they are the sole authors of the manuscript.
- Proper credit is given to the sources of information, ideas, or text used in the manuscript through appropriate citations.

3. Plagiarism Detection:

All submitted manuscripts undergo a thorough plagiarism check using plagiarism detection tools. The editorial team, including reviewers, is vigilant in identifying and addressing any potential cases of plagiarism.

4. Actions in Case of Plagiarism:

If plagiarism is detected in a submitted manuscript, the following actions will be taken:

- The manuscript will be immediately rejected.
- The corresponding author will be notified of the plagiarism findings and the rejection decision.
- The details of the plagiarism detection will be kept on record.
- The authors' institutions may be informed, if deemed necessary.
- Similarity percentage of each manuscript is 20 % from the entire manuscript.

5. Author Responsibilities:

Authors are responsible for: Ensuring that all submitted work is original and properly cited. Acknowledging and citing sources appropriately for text, data, images, or ideas borrowed from other works. Seeking permission for the use of copyrighted material and providing proper attribution.

6. Editor and Reviewer Responsibilities:

Editors and reviewers are responsible for: Vigilantly reviewing manuscripts for any signs of plagiarism. Reporting any suspected cases of plagiarism to the editorial team. Maintaining confidentiality and reporting findings to the authors and relevant institutions, if necessary.

7. Plagiarism Prevention:

Authors are encouraged to use plagiarism detection tools before submitting their manuscripts. Proper citation practices and adherence to citation styles (APA, MLA, Chicago, etc.) should be followed. CINEC Academic Journal Citation style is APA.

8. Appeals:

Authors have the right to appeal a plagiarism decision by providing evidence and clarification. Appeals will be considered on a case-by-case basis.

9. Continuous Improvement:

This plagiarism policy is subject to periodic review and updates to align with best practices and evolving standards in academic publishing.

10. Contact Information:

For inquiries related to this Plagiarism Policy, please contact us at caj@cinec.edu

7. QUALITY POLICY

Mission Statement:

CINEC Academic Journal is dedicated to serving as a platform for the dissemination of high-quality, multidisciplinary research conducted within our academic community. Our mission is to foster intellectual exchange, advance knowledge, and contribute to the scholarly discourse across diverse fields.

Purpose and Objective

The quality objective of CINEC Academic Journal is to ensure high standards in the article publication of diverse research from various disciplines. This quality policy outlines the principles and guidelines for maintaining high standards of academic integrity, editorial rigor, and ethical conduct in the publication of the multidisciplinary of CINEC Academic Journal. The policy aims to ensure that the journal consistently publishes high-quality, original, and well-researched scholarly works that contribute to the advancement of knowledge across various disciplines.

Editorial Integrity:

Uphold the highest standards of editorial integrity through transparent and unbiased peer-review processes. Ensure that the editorial board is comprised of experts representing various disciplines to maintain a multidisciplinary focus. Safeguard against conflicts of interest in editorial decisions.

Author Support:

Provide comprehensive author guidelines that assist in the preparation and submission of well-organized manuscripts. Support authors in adhering to ethical standards, ensuring the responsible conduct of research, and maintaining integrity in reporting.

Peer Review Excellence:

Engage knowledgeable and diverse peer reviewers with expertise across the spectrum of disciplines covered by the journal. Facilitate constructive and timely peer-review feedback to enhance the quality and impact of published articles. Ensure confidentiality and fairness in the peer-review process.

Ethical Publishing Practices:

Uphold ethical standards in publishing by addressing issues such as plagiarism, data fabrication, and authorship disputes. Implement measures to prevent and detect research misconduct. Adhere to ethical guidelines and best practices outlined by relevant organizations and bodies. **Accessibility and Inclusivity:** Strive to make research findings accessible to a wide audience, fostering inclusivity and collaboration. Support open access initiatives to maximize the dissemination of knowledge. Promote content that reflects the diversity of perspectives within our academic community.

Continuous Improvement:

Regularly evaluate and enhance editorial processes based on feedback from authors, reviewers, and readers. Embrace technological advancements to streamline operations and improve the overall quality of the journal. Stay abreast of developments in various disciplines to remain relevant and responsive to emerging trends.

Compliance:

CINEC Academic Journal is committed to complying with all relevant industry standards, ethical guidelines, and legal requirements. The editorial team will actively monitor and address any deviations from established policies.

Review and Revision:

This quality policy will be periodically reviewed and revised to ensure its continued alignment with the goals of CINEC Academic Journal and the evolving needs of our academic community.

Adherence:

All stakeholders, including editors, authors, reviewers, and the broader academic community, are expected to uphold and contribute to the fulfillment of this quality policy laid down by the governing body of the CINEC Academic Journal.

Quality Policy for a Multidisciplinary Campus Journal

Purpose

This quality policy outlines the principles and guidelines for maintaining high standards of academic integrity, editorial rigor, and ethical conduct in the publication of the multidisciplinary campus journal. The policy aims to ensure that the journal consistently publishes high-quality, original, and well-researched scholarly works that contribute to the advancement of knowledge across various disciplines.

Scope

This policy applies to all aspects of the journal's operations, including:

- Manuscript submission and review process
- Editorial decision-making
- Publication ethics
- Plagiarism detection and prevention
- Copyright and intellectual property rights
- Journal management and governance

Principles

1. **Academic Integrity:** The journal upholds the highest standards of academic integrity and expects all authors to adhere to ethical principles of research and writing. Submissions must be based on original research, free from plagiarism, and appropriately cite relevant sources.
2. **Editorial Rigor:** The journal employs a rigorous peer-review process to ensure the quality and validity of published articles. Submissions undergo double-blind review by experts in relevant fields, and editorial decisions are based on the merits of the research and its contribution to the field.

3. **Ethical Conduct:** The journal adheres to ethical guidelines for research, publication, and authorship. Authors must disclose any potential conflicts of interest, and the journal takes appropriate measures to prevent and address ethical breaches.
4. **Plagiarism Detection:** The journal utilizes plagiarism detection software to identify and address potential instances of plagiarism. Authors must ensure that their work is original and does not infringe upon the intellectual property rights of others.
5. **Copyright and Intellectual Property:** The journal adheres to copyright laws and respects the intellectual property rights of authors. Authors retain the copyright to their published work, subject to the journal's publishing agreement.
6. **Journal Management:** The journal is managed by a team of qualified and experienced editors and editorial staff who are committed to maintaining the journal's high standards of quality and ensuring its ethical operation.

Implementation

This quality policy will be implemented through the following measures:

1. **Manuscript Submission Guidelines:** Clear and detailed submission guidelines will be provided to authors, outlining the journal's expectations for manuscript format, content, and ethical considerations.
2. **Peer-Review Process:** A rigorous peer-review process will be followed, involving independent experts with relevant expertise in the field of study. Reviewers will be provided with clear guidelines and evaluation criteria to ensure consistent and high-quality assessments.
3. **Editorial Decision-Making:** Editorial decisions will be made based on the merits of the research, its contribution to the field, and its adherence to ethical principles. Editors will maintain transparency in their decision-making process and provide authors with constructive feedback.
4. **Ethical Conduct Procedures:** Clear procedures will be established to address potential ethical breaches, including conflicts of interest, plagiarism, and data fabrication. Authors will be informed of these procedures and encouraged to report any concerns they may have.
5. **Plagiarism Detection and Prevention:** Plagiarism detection software will be regularly used to screen submissions for potential plagiarism. Authors will be educated about plagiarism prevention strategies and the consequences of submitting plagiarized work.
6. **Copyright and Intellectual Property Management:** Clear copyright policies will be established and communicated to authors. The journal will ensure that all necessary copyright permissions are obtained and that authors' intellectual property rights are respected.

7. **Journal Management Structure:** A well-defined management structure will be established, with clear roles and responsibilities for editors and editorial staff. Regular meetings and communication will ensure the efficient operation of the journal.

Review and Continuous Improvement

This quality policy will be reviewed periodically to ensure its effectiveness and relevance in maintaining the journal's high standards. Feedback from authors, reviewers, and editors will be considered in the review process. Continuous improvement efforts will be undertaken to enhance the quality of the journal and its contribution to the academic community.

8. PRIVACY STATEMENT

CINEC Academic Journal, we (Journal Management Team) are committed to protecting the privacy and confidentiality of our authors, reviewers, editorial board members, and users. This Privacy Statement outlines how we collect, use, disclose, and protect personal information associated with our journal.



Millennium Drive, IT Park, Malabe.
Tel: + 94 11 4486400 Fax: + 94 11 2413505
Email: info@cinec.edu
Website: www.cinec.edu